LORD LISTER
HIS LIFE & WORK

G. T. WRENCH

Dr Collier

at the time of Herbert's first convalescence

with sincere thanks and love.

W. and E. L. Sackett.

Sept 5 1913.

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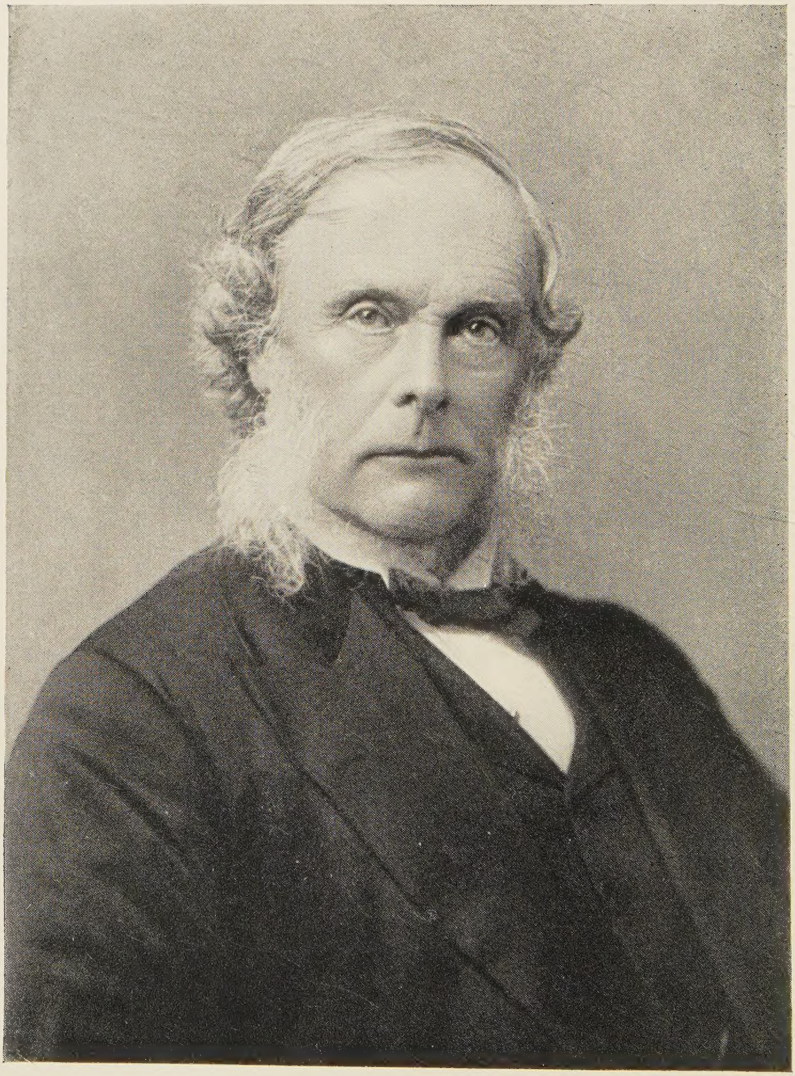

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LORD LISTER.

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LORD LISTER

HIS LIFE AND WORK

BY

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TO

MY ELDER BROTHER,

CHARLES,

AS A TOKEN OF AFFECTION

AND RESPECT.

INTRODUCTION

It is impossible to separate a genius from all time. His work, however much it may be concerned with the special features of the period in which he lived, is always founded upon the first principles of life. Therein lies its distinction. The work of most men is concerned only with the setting and spirit of the times in which they themselves live. But the work of a genius is based upon the unchangeable foundations of human life and earns, in consequence, its immortality.

The life and work of the late Lord Lister was of this kind. It affected man's relation to sickness and disease more fundamentally than the work of any other philosophic physician devoted to these problems. For Lister was emphatically far more than a great surgeon: he was far more the founder of modern surgery. He was a great philosopher whose thought never deviated from the central problem of life the mystery and quality of vitality. As a philosopher Lister is far too little known. Yet in the growing recognition of the essential physiological basis of life in all its branches and manifestations, political, social, and religious, the name of Lister

will grow in greatness. As yet, however, even in the more privileged circles of his own profession, the recognition of the astonishing power and simplicity of his thought is but meagre. Only recently one of the most distinguished surgeons of our time summed up his impression of Lister to me as a man who, chancing on a great discovery, pushed it with the pertinacity of a Scotchman. How fallacious such an estimate is the present book will show. In part this estimate was due to the general ignorance about one of our greatest Englishmen, for Lister was English, not Scotch. This ignorance itself is largely due to Lister's modesty, the modesty of great men which makes them certain that by their works they will be proven and makes them shun the loud proclamation to their own generation of the gifts that will have value for all time.

Disease is the shadow of death that clouds the life of man. When Lister was born this shadow was probably deeper than at any other time, so deep, in fact, that it threatened the very existence of industrial populations. The problem, then so urgent, has always been one that has vexed man from the beginning of history. A brief preliminary glance at man's philosophic attitude to disease, by which he attempted to discover the reason of its existence, is necessary in order that the place of Lister may be properly appreciated.

The Babylonians paid great heed to the

problem and mystery of disease. Devoutly believing in the unity of man's being with the universe, they wove man's fate into the successive changes of the brilliant stars of their heavens, and reconciled apparent chance and law in the constancy of their inconstancies. The demons of disease sallied forth to their fell work supported by some strange congress of the stars. The primary health of man became read in terms of the macrocosm, his healthy vitality conceived of as the reward of a proper unity between him and the universal power. So even in this early stage of man's history one sees disease shadowed forth as a problem primarily of the disturbance of man's vitality and secondarily of the demons that take advantage of his lowered vitality.

The Egyptians were probably the most healthy people of history. Herodotus spoke of them as the healthiest nation, and Diodorus said that from the king to his humblest subject the mode of life in Egypt seemed as if ordered by the physician rather than the lawyer. The Egyptians staved off disease by a reverent attention to the vitality of the body. They were the first people to master the question of antisepsis. By cassia, frankincense, and myrrh they preserved the body from the microbes of dissolution. But whether it was that their vitality shielded them during life from notable microbic attack or some other reason prevailed, they confined their use of antiseptics to the preservation of the dead from dissolution and not the living from disease.

Introduction

The Greek attitude to disease is chiefly centred round the name of Hippocrates, the Father of Medicine, and the contemporary of Socrates, the Father of Reason. Both these philosophers tended to ignore the primary question of vitality and saw the fate of man in outward things, in the environment of modern terminology. Hippocrates believed in the ruling power of God, but separated disease from the relation of man's life to the overruling power. "Every disease has its own particular mode of production from natural causes," he wrote. Hence he is called to-day the father of medicine by the profession, which pays too exclusive a heed to the incidental causes of disease, the causes that come from without, and has not yet grasped the profound significance of Lister's teaching upon the central problem of the quality of human vitality. With Hippocrates the physicians of to-day tend—often with right, but not always so—to regard those, who seek to understand the profounder problem as to why disease, so rare in animals and natural or savage peoples, should be so prevalent amongst the civilized, as faith-healers, purifiers, vagabond priests, and impostors (*μάγοι καὶ καθάρται καὶ ἀγύρται καὶ ἀλαζόνες*).

Hippocrates was followed by the anarchy of thought which ensued with the decadence of Greek civilization. Quackery, peculiar cures, and sects were the transient fashions and means of combating the increasing disease. Galen, the Court physician to the Emperor Marcus Aurelius,

attempted to restore some imperial power and order to the anarchy of medicine. He was followed by Christianity, with its exclusive regard to the spiritual side of life. In the knowledge of the body, its vitality and physiology, a thousand stagnant years followed the era of Galen, years in which sickness and disease grew apace and often reached an appalling magnitude. The works of Galen and Hippocrates were only saved from the deluge of theology by the followers of Mohammed, who were the first to establish an efficient hospital system with medical training colleges and physicians to govern both.

With the revival of learning the body once again received attention from learned men. The knowledge of physiology and anatomy increased. William Harvey (1578–1657) discovered the circulation of the blood. Antony von Leeuwenhoek in 1683 discovered the existence but not the significance of microbes. Some rarer thinkers employed themselves with the philosophy of disease as a whole, and of them I would choose the noble Fleming van Helmont (1577–1644) as the most devout and coherent genius. According to van Helmont, a ruling and living spirit, which he named the Archæus, dwelt in and governed the whole organism of the body, and in every bodily organ or structure dwelt lesser spirits or local Archæi. Disease was either due to an attack upon the local Archæus, which eventually affected the central Archæus, or else it was a defect or morbid humour of the central Archæus. The

symptoms of disease were the evidence of the anger of the Archæus, the fever was the heat of his anger, the secretions poured out were his attempt to soothe injured or irritated tissue. In this form van Helmont expressed the central vitality and the local vitalities of the body which Lister so admirably demonstrated and in which he found the final clues to the mystery of disease.

Between van Helmont and Lister nothing was added to the fundamental philosophy of disease, though detailed knowledge was much increased. I cannot, therefore, bring this brief Introduction to a close in a better manner than by quoting the prayer of van Helmont, which he uttered in despair after finishing his review of medicine and the terrible prevalence of disease: "O merciful God, how long wilt Thou be angry with man, that Thou hast not revealed one truth to Thy students in healing? Is this Moloch sacrifice pleasing to Thee, and wilt Thou that the lives of the poor, of widows, and of children, be continually offered up to Thee in miserable torments of incurable diseases or through the carelessness and ignorance of physicians?" The prayer was not uttered in vain, and that it was not uttered in vain has been due, under Providence, to the life and work of Lord Lister.

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LORD LISTER

CHAPTER I

LISTER'S CHILDHOOD AND STUDENT DAYS

THE neighbourhood of West Ham is not noted for the crystalline atmosphere, the dry, exhilarating airs, and the azure sky one is wont to think of as favouring the cradle of genius. Yet it was in this neighbourhood, in Upton Lane, that Joseph Lister was born, upon April 5, 1827.

In 1827, however, West Ham was more genial than it is now, and Upton itself was a village set amidst pleasant meadow-lands. The River Lea, now "enamelled filthily with many hues," then wandered through verdant fields where cattle grazed and the scent of meadow-sweet and cowslips burdened the summer air.

In this pleasant neighbourhood of London a number of Quaker families had gathered. The chief of these was that of Samuel Gurney, known as the "bankers' banker" and head of the greatest discounting house in England. His sister, the famous Elizabeth Fry, who herself did so much for the sufferers in hospitals and prisons, also lived near her brother.

The Listers were a Quaker family, and Upton therefore offered attractions to Joseph Jackson Lister, the father of Lord Lister, and son of John Lister, a London wine merchant, whom he followed in business. The Listers were, like most Quaker families, men of sober and capable character, earning both a good name and comfortable wealth in business. Joseph Lister, the elder, took a house, still known as Upton House, and situated in Upton Lane. At that time Upton House was surrounded by a spacious garden and fields, the whole estate counting sixty-nine acres. The estate is now cut up into roads lined by rows of workmen's cottages, but the house still exists and forms to-day the vicarage of St. Peter's Church. It is an ideal family house, solidly built and admirably proportioned, with an exterior which, in spite of the inevitable London grime, is dignified and pleasing. The rooms are large and suitable to the expanding activity of childhood, with staircases, passages, cupboards, and nooks, which seem specially designed for children's romps and glorious games of hide-and-seek. Immediately opposite to Upton House was Ham Park and House, belonging to the friends of the Listers, the aforesaid Samuel Gurney and his family, a neighbourhood that was a delightful one to the children, but which once was nearly the occasion of a disaster to young Lister. A friend was shooting in Ham Park, and in his excitement shot in such a way that the pellets of his gun passed through the

UPTON HOUSE, WHERE LISTER WAS BORN.

(Block lent by the West Ham Corporation Electric Supply.)

window of the dining-room of Upton House and embedded themselves in the wall against which the boy was standing.

Lister's father was a man of marked though not great genius. As a child he was short-sighted, and in order to see the landscape more comfortably from his nursery window he was accustomed to glue his eye to an air-bubble which had become imprisoned in the glass. The air-bubble acted as a lens, and enabled the boy to see the country with greater ease. Only a genius could be led to a valuable discovery by such a simple observation. Lister, the elder, was such a genius. From the time of his youth the subject of optics absorbed his leisure. At that time microscopes of high power always presented an image with blurred and coloured outlines, which obscured the clarity and decision of presentation. Lister set himself to overcome this obstacle. But it proved embarrassing. Experiments with glasses variously arranged led to conflicting results. Lister, however, was not to be baffled. He had the tenacity, the carefulness, and the judgment that were in such abundant measure the qualities of his more famous son. He had obtained results from his experiments which seemed highly contradictory. He brooded over them, and out of the irreconcilable educed in 1830 a common principle upon which the construction of the high-power lenses of the microscope have since been based. Acting under its guidance, he was able to put together sets of

lenses so that the blurring of the picture was abolished. The law of aplanatic foci which he evolved enabled him to make the first perfect English achromatic microscopes.

In recognition of his scientific achievements, Lister received the high distinction of being elected a Fellow of the Royal Society, being the first man to establish a firm reputation upon a bubble.

In 1818 he married the daughter of Anthony Harris, of Maryport, Cumberland. Their union was blessed with seven children—four sons and three daughters. Joseph Lister was the second son. The home atmosphere in which he was brought up may be said to be that in which he continued to live all his life. It was one of comfortable affluence, earnest faith, and practical goodwill, the qualities distinctive of a great number of Quaker families, added to which was the devotion to science and to microscopical study which was the chief occupation of his father's leisure hours.

The child is father of the man, and as a child Lister displayed upon the smaller stage of childhood the character which later earned for him such high regard. He was affectionate, and to the end of his life showed the same devotion to his family. He was merry and full of high spirits at home, but shy with strangers, and from the first he displayed an unusual gravity and high conscientiousness whenever the more serious side of life was approached. His conscientiousness

was, indeed, peculiarly sensitive, and gave him a refined sense of truth both to himself and to others, which showed him as free from guile, and gave him the accurate sense of reality which became so profitable to the world.

His life as a child was happy and serene. There are no notable anecdotes connected with it, and he himself was the last to desire the repetition of such anecdotes. "A scientist's public life lies in the work that is his," was his saying, and in the biography of his father which he wrote for the "Dictionary of National Biography," he carefully observed this rule. He made no mention of the childhood or private life of his father, but retailed in full the history and character of his contribution to the world's knowledge. Such is the standard of scientific biography which Lister himself set, a standard he was anxious should be observed in the case of his own life.

His early education was given to him at the Quaker school, at Grove House, Tottenham. Amongst his schoolfellows was Wilson Fox, the well-known physician, who was three years younger than Lister, and William Forster, the Liberal statesman, who was a few years older.

The headmaster of the school was a Mr. Binns, a good but in no way remarkable man. The character of Mr. Binns with the traditions of Quakerism formed the character of the school. To us, who in these latter days have what, I cannot but think, is a somewhat dangerous free-

dom, the records of this school give a picture of unerring and almost stupefying goodness. The masters were good, the boys were good; the address of the Friends in the "thou and thee" and the eminent piety of the Quakers ruled throughout. But of the high moral stamp the school gave to its pupils there can be no question, and this school confirmed in young Lister the strictness of his sense of truth and of his duty to his fellow-men, from which in later life he never for one instant swerved. The intellectual education that was given to him was thorough both on the classical and scientific sides, and he proved himself an able pupil, distinguished by thoroughness rather than brilliance. Both at school and with his father he learned to observe and record accurately, and he soon became familiar with the microscope and the preparation of sections. He also proved himself a good linguist, and at a later date upon his tours abroad was able to address his audiences in either the German or the French languages, an unusual accomplishment for an Englishman who had not lived in the countries where they are spoken.

From this efficient school Lister in 1844 proceeded to University College. The familiar building in Gower Street, designed by William Wilkins, R.A., and perhaps the most pleasing piece of classical architecture in London, had been built only a few years. It owed its origin to a letter from the poet Thomas Campbell to the *Times* in 1825. Campbell urged in a

very powerful manner the establishment of a University of London. Oxford and Cambridge of course were outraged at this suggestion, but in the teeth of the opposition of the many powerful sons of the classical universities, the project was carried through and the Gower Street building erected as the home of the new university. It was known as the University of London up to 1836, but at that date the University was separated from the specific building, which then became known as University College. But it maintained its premier position in London education, and in sending his son to the College the elder Lister gave him the best education in England, apart from the peculiar social standing that the older universities alone could give.

Lister matriculated in the year 1845, and though he passed his examination with distinction and received honours in classics and botany, he did not single himself out by gaining a scholarship or gold medal. Two years later he took his B.A. degree, but failed to distinguish himself by earning either gold medals or honours. Though he had a sound general knowledge, he had not the exceptional power of storing other people's facts and opinions which is, perhaps, the chief faculty through which a student gains distinctions in these examinations. Where originality had greater weight, there, as we shall see, he at once became notable.

The scientific bent of his father and his own inclination led Lister to take up the study of

medicine, and he passed directly from University College to University College Hospital and its medical school. The choice was a peculiarly happy one and a part of that general rightness and lack of wastage by blunder and error which was characteristic of Lister's whole career.

Before the foundation of University College and its hospital medical education in London had been in a deplorable way. It was without shape or organization. There was no examining body which could give a student a doctor's degree. A student in London, he studied in London, but to earn his degree he had to be tested elsewhere, and by men who did not always regard metropolitan products with eyes free from jealousy. The aspiring student was, therefore, semi-detached. He had to contort his mental vision so as to fix his attention upon his London studies and his future judges at the same time, and to consider whether the particular method he was being taught would be approved of by his examiners and therefore worth learning.

The absence of organization which characterized the system of examination for degrees was also to be found in the teaching. Capable and efficient teaching could only be got if the student was fortunate enough to place himself under a zealous master. At some medical schools consequently lectures and instruction were efficient, at most they were inefficient, able in one subject, feeble or altogether lacking in other subjects,

and in general extraordinarily short and cursory compared to the efficiency that with order might have been obtained. Thus the celebrated surgeon Cline combined anatomy, physiology, and surgery in one course, and he was held to be one of the ablest and most thorough of teachers; and at St. Bartholomew's there was no class in anatomy at all. The anatomy of the human body is a matter of some familiarity to many people of the present day, but at the beginning of the nineteenth century it was not well known even to the students and practitioners whose business it was to see that the body could be restored to good working order. Nor did the Government or public opinion help the profession in this matter, but refused official recognition to the obtaining of the necessary material, and by their opposition promoted the horrible and secret system of body-snatching that prevailed. Men known as Resurrectionists used to dig bodies out from the graves or waylay drunken men in the alleys of London, throttle them, and take their bodies to the anatomists, who paid them from £5 to £15, according to the "market value," and asked no questions.

The apprenticeship system of learning medicine was also in vogue, under which a student was only compelled to walk the hospitals for fifteen months and could spend the rest of his time under a practitioner, with whom he as a rule learnt much shrewdness, more humbug, and no science.

Lister entered medicine as a student when this deplorable, haphazard inefficiency was being rapidly eradicated. The Anatomy Act had been passed owing to the strong representations of some leading London men, and the abomination of body-snatching thereby done away with. The same men and others of influence established the London University, and in the University College Hospital and Medical School set up a well-ordered system of medical education, which was to be the standard and example eventually to be followed by all other medical schools and hospitals. Professors were appointed, regular and thorough courses of lectures in chemistry, materia medica, medicine, anatomy, physiology, and surgery were for the first time given, and the period of study was doubled.

It was into this excelling system and hospital that Lister entered in his twentieth year. He had not notably distinguished himself in his schooling and examination for the B.A. degree. But directly he entered medicine Lister got into his stride. He was soon recognized as the best student of his year, and it was clear that he was destined for high honours. His first examination stamped his value. The University examiners gave four gold medals. Lister procured two of them and was very close to securing the other two. In 1852 he took the degree of M.B.Lond., and once more showed his capacity. Besides distinguishing himself in other subjects, he took the gold medal and scholarship in

surgery, and thus started where he ended, at the very top of surgery. In the same year he became a Fellow of the Royal College of Surgeons.

In his student career Lister came across three men who had a marked effect upon him and his career. The first was Professor Lindley, the botanist. Lister gained with him the love of flowers which gave him so much pleasure. Upon all his holidays and excursions he gathered the flowers that he saw and carefully pressed and preserved them, and his collection of Alpine flora eventually became a large and valuable one. It was not as a scientist that he pursued this hobby of botany, but as a genuine lover of the wonderful beauty the many flowers of the hill and field yield to those who search for it; and Lister found no distraction from the horrors of hospital more gentle or effective than that which the bright blossoms of the country offered. The other two men were also professors. Thomas Graham, the able professor of chemistry, taught Lister the grasp of chemistry which was of great value to him in his later work. The last friend and teacher was a very remarkable man who made a great impression upon his students, William Sharpey, the Professor of Physiology. Sharpey was precisely the type of man to inspire a youthful enthusiast. Destined for medicine, he studied at Edinburgh and Paris. At Paris he formed a lifelong friendship with James Syme, Lister's future master and father-in-law. Re-

turning to England, he went into general practice, but soon found that practice without progress was unsuitable to his aspiring mind. He determined, therefore, to devote himself to a single province of the medical art, and he carried out this determination in a very singular way.

With a knapsack upon his back and a staff in his hand he set out in 1826 to tramp on foot through France and Switzerland to Rome and Naples, studying at all the famous places *en route*. In 1828 he turned northward, passed through Bologna, studied with the famous Panizza in Padua, went on via Venice and Innsbruck to Vienna, and later by Heidelberg to Berlin and home, having spent three years upon a pilgrimage that is unique in medical history, and bringing back the weight of all Europe's knowledge in physiology and anatomy, together with a knapsack full of material goods. The Governors of University College, astute in securing the best men of the time, appointed him professor.

His work and lectures revolutionized physiology and made it the vital science that it is to-day. In Germany, especially, he had learnt the value of the microscope in examining the minute tissues of the body, and he combined his knowledge of their minute structure with the functions they carry out in such an absorbing manner that his lectures were crowded and their substance became classical.

It is scarcely likely, therefore, that such a man would not be interested in the son of him who

had shown himself to be "the pillar and source of all the microscopy of the age." He became interested in young Lister, and the latter soon became his favourite pupil. Sharpey was a man, not only of lively enthusiasm and originality, but of commanding presence, and it was but natural that a student would respond to his personal power. With his help Lister began that combination of research work with his practical work which developed into the keen two-edged sword of his later execution.

His first piece of scientific research was carried out in 1852. The subject was one in no way connected with his later work, though he made some slight use of it. It was, indeed, the fortuitous product of an observant student. Mr. Wharton had occasion to remove a piece of iris from a patient's eye. The iris is the screen or shutter which regulates the amount of light that enters the eye by making the pupil smaller or larger, and also gives the eye its characteristic colour. The means by which the iris dilates and contracts were not then well known. Lister, whom Sharpey had interested in the general question of automatic or involuntary muscles and who was present at the operation, took his opportunity. He examined the piece of iris and was led from it to an examination of the irises taken from dead animals. The work preceded the passing of his final examination, and with this ordeal, properly dreaded by all students, before him, he was unable to complete his work to his

satisfaction. As he modestly worded it: "My engagements do not allow me to carry the inquiry further at present; and my apology for offering the results of an incomplete investigation is that a contribution tending, in however small a degree, to extend our acquaintance with so important an organ as the eye, or to verify observations that may be thought doubtful, may probably be of interest to the physiologist."

In spite of this modest approval of its author, the paper was considered worthy of publication in the leading microscopical journal, which was no small honour to a student. One cannot help musing over this beginning of Lister's course. The paper did, as a fact, show the way in which the iris acted, as was confirmed by later work, but it itself was not complete. As such, though the first piece of original work Lister ever did, it is unique in being the only one that he ever published in an incomplete state. In future he never gave anything out until he was quite satisfied that it was complete in itself. In this he resembled his great contemporary Charles Darwin, though the vital importance of Lister's work to his fellow-men compelled him to publish each completed step of his progress. The examination of the involuntary muscles of the eye led Lister to an investigation of that curious condition which is due to the contraction of the small muscles in the skin and which is popularly known as "goose-skin." The paper confirmed the "simple and beautiful

explanation" of Professor Kölliker. Both this and the previous paper were illustrated with some exquisite and accurate drawings by Lister himself, who had an exceptional talent of which, as of his other gifts, he made great use in his work of discovery.

These early papers had no particular bearing upon Lister's later work, though his later work had a very definite bearing on them. For it is an interesting witness to the way in which Lister's discoveries delved into every part of medicine, that these early investigations, then so difficult, would now be easy, and this ease has come through the application of Lister's principles and practice to microscopical science. Lister in his first paper expressed his gratitude that the iris tissue did not decompose so rapidly as he had anticipated, and that consequently he had time for his observations. But now in the light of the knowledge that he has thrown upon decomposition there is no need for hurry, and both microscopical tissues and the body by dissection can be examined at leisure. It is a technical matter, but in effect it means this, that Lister in discovering the way to prevent the decomposition of wounded tissues in the living, opened the way to the prevention of decomposition in the dead tissues, whether in the dissecting-room or the laboratory. The good that has resulted therefrom to medicine and surgery, and through them to mankind in general, is a part of the cumulative effect of Lister's genius.

Although it seemed that young Lister, under the influence of his father and Sharpey, would direct himself to microscopical anatomy, yet even at University College Hospital, in combination with this work, the first movement of the symphony of his life had begun. In his surgical studies he was first dresser and then house-surgeon to John Eric Erichsen, the Anglo-Dane and author of one of the most famous textbooks of surgery in the English language.

As house-surgeon Lister had patients put definitely in his charge. Such direct contact with the actual gives above all the real chance to originality. No parent or teacher, however helpful, supervened; and Lister for the first time became intimately acquainted with the appalling forms of blood-poisoning, and above all the terrible disease, now banished by his work, known as "hospital gangrene"—a disease in which wounds that should heal cleanly became the centres of spreading mortification, and the living tissues rotted away with fearful rapidity. Lister had now to deal with this disease. The method in vogue was to put the patient under chloroform and burn the mortified flesh away with caustics. Sometimes this treatment was successful, sometimes in a few days the greyish film would appear at the edge of the wound again, presaging the general greyness of death that ensued. But the very fact that the treatment was sometimes successful riveted the attention of the positive, constructive mind of Lister. To discover how

that success was brought about, therein lay the clue to the disease and its conquest.

Up to that time the cause of putrefaction in wounds, of gangrene and suppuration, had loosely been held to be the oxygen in the atmosphere, which set up fermentation in the juices of the wound. Lister had the genius to see the obvious instead of the conventional. If sometimes caustics burnt away the disease, clearly they burnt away, not the oxygen in the air, but something purely local, something in the wound itself which could sometimes be destroyed, and this local thing was the cause of the disease. Lister set out to find it with the enthusiasm and hope of a young scientist. He did not himself publicly speak of the burning hope that filled his breast, but any young scientist who has entertained a like vision can be sure that he was elated. He took his microscope and carefully examined pieces of the diseased tissue. He saw certain peculiar objects. In them, perchance, he saw the cause of this awful disease. One can, again, imagine that he felt the thrill of a great hope, that seems to make one expand as heat makes metal expand. But Lister only recorded in sober scientific language: "I imagined they might be the materies morbi in the form of some kind of fungus." The investigation got no farther than this seeing. He knew of no means then of furthering it, nor were there any means. He was far from being ripe for discovery. One cannot leap to great truths until long training

and care have made the leap possible and accurate.

Lister, therefore, merely held in his thought the possibility of a minute living organism as the local cause of the disease. He made notes of his observations and drew his usual careful and excellent pictures. So accurate were the latter that, speaking fifty years later, he said these pictures were still of use to him, a striking illustration of the continuity and harmony of his life, which justifies one in calling these first observations and meditations the first movement in the symphony of his life.

As to Lister himself in these days, he is described as a youth of average height but slender build, with a large intellectual head, a lofty brow, and a grave and earnest face. His hair was dark and luxuriant, and he wore the side-whiskers that were common at this time. He used to dress in black, wearing a high collar and black stock and the peculiarly cut coat that denoted that he was a Quaker. Altogether he presented rather a sober figure for a youth, but one impressive to those who could read a character of profound thoughtfulness and noble sincerity and feeling.

But upon his holidays and with those he loved his gravity fell from him, and he showed the gaiety that is more deep, if one may use the term, because of that very gravity, having a sincerity in it, a genuineness, an originality that separates it from the more imitative and artificial gaiety of

lesser natures. He had the gaiety that was glad, but had no need of company, not the gaiety that is only aroused by company, and he possessed it all his life, so that though a grave and serious man to the eyes of most, he was never a sad man. He was fond of open-air exercise, and especially of swimming. The latter exercise led to an observation which I think to be of great interest. When bathing and swimming in the sea the fishermen watching him were wont to speak in terms of admiration of his excellently proportioned and graceful form. His brother and other friends bathing with him were healthy and well-built fellows, but Lister showed himself favoured with a singular perfection of body. To me it seems that such perfection of physique is rarely, if ever, absent from great constructive genius.

Lister's repute with his teachers at University College was high. His zeal and earnestness impressed them. By the students he was regarded with equal consideration. In their medical society he was elected secretary and later president. Associated with him in this society were young men of quite exceptional quality. Besides himself, three other students succeeded to the rare honour of the Fellowship of the Royal Society: Sir William Flower, the zoologist, J. S. Gamgee, eponymously popular in "Gamgee tissue," and Sir William Roberts, the physician. Other names familiar to all medical men were associated with his. It was a period of

exceptional vigour, but there can be little doubt that much of this vigour was due to the zeal with which Lister's profound and earnest personality inspired the more capable students with whom he came in contact.

CHAPTER II

LISTER AND JAMES SYME

AT the anniversary dinner of the Royal Society in 1902, Lister, made President in 1895, rose to respond to the highest honour the Society could confer upon him, the gift of the Copley Medal. In acknowledging the honour he declared that perhaps his chief merit lay in the fact that he worked for years together with exceedingly little encouragement from his professional brethren. There were, however, two great exceptions, his father-in-law, James Syme, and his students.

Sharpey, Syme's friend, knew the value of personality in developing genius. Lister had finished his house-surgeoncy at University College Hospital, and Sharpey, in looking round upon the distinguished surgeons of his time, found no more distinctive figure than that of his friend and fellow-student to whom he could entrust the further fate of his favourite student. So he gave Lister a letter of recommendation and sent him off upon a medical pilgrimage to Edinburgh, where Syme had already been professor of clinical surgery for twenty years.

Once again one is apt to think that Lister was

blessed with a providential good fortune. Not only was he gifted with a handsome presence and a fine intellect, but he was also favoured with a healthy and happy home, a sympathetic and highly talented father, a school which confirmed and strengthened the definite shape of his character, the leading medical school for his education, and in Sharpey the most original and zealous of teachers and friends. It was indeed a happy combination, but one must not forget that a positive, helpful, and world-befitting genius will probably spring from good stock, and that such a genius, by good judgment and through the favour that is shown to obvious merit, will make very few errors in the forward path, and that what seems the result of happy chance is really due to ability. It is only when the creations of genius run counter to the conventions of man that the struggle comes.

The decision of Lister and his friends for him to visit James Syme was fully in accord with the happy sense of his life. As Sharpey was the most talented and original physiologist of his time, so Syme was the most remarkable surgeon.

Unlike his adventurous friend, who tramped a pilgrimage through Europe, James Syme was rooted to his earliest associations. Born in Edinburgh, he reaped his fame in Edinburgh and died in Edinburgh. He was, as has been said, the peer of surgery in his day. Throughout the kingdom, and probably throughout Europe, there was not his equal. And when one says he was the

finest surgeon, one also says that he was a man of fine quality. In these days, when surgery has so many conveniences, the personal character of the surgeon, though playing a part, is not so dominant as it was in the days of James Syme. Then it was all-important, and James Syme's character had the qualities which go to the making of a surgeon in an eminent degree. It may seem strange to say they are like to those of a skilled mountaineer. The comparison may appear romantic, and undoubtedly the Alpine climber has a more picturesque and exhilarating setting for his qualities of character than has the surgeon. Nevertheless there is a marked resemblance. Both need a combination of caution and daring of the highest degree. Both have to be swift, apt, and cool-headed in sudden danger. Both have to be quick to discern and pursue small indications of advantage upon which success and even life depends, and once started on a venture, they can rarely turn back. Fearlessness, firmness, aptness, swiftness, sureness—such are the qualities of the great surgeon, especially in the past, and of the great climber. They were the qualities of James Syme. In the words of Dr. John Brown, the author of "Rab and His Friends," and the intimate friend of Syme, he was *verax, capax, perspicax, sagax, efficax, tenax.*

At the age of twenty-four Syme, when lecturer on anatomy at Edinburgh, performed the operation of amputation through the hip-joint for the first time in Scotland. Only a medical man

can fully appreciate what such an operation then meant. It meant a terrific loss of blood, a greater collapse, and an imminent danger of the death of the patient under the knife. The living being placed under the surgeon's care and submitting to the trial upon his advice, was sure to skirt the borders of death, and would in a few minutes after he had placed himself under the knife, quivering and conscious—for then there was no chloroform—moan, grow pale and yet paler, with white lips and beaded brow, until the grey of death perhaps crept into the blanched face. A great operation must have been an appalling trial to any surgeon in those days, and still more to a young surgeon. Yet under the eyes of his seniors, with a magnificent confidence in his own complete familiarity with anatomy and his iron nerve, young Syme dared "the greatest and bloodiest operation in surgery," for the first time —that is to say, without having seen or assisted at the operation previously. He was successful, and from that time his name as a surgeon was established. He passed from this operation to many feats that were probably the most hazardous that any one man has dared, and dared successfully, upon the living bodies of other men.

Syme was more than a great operating surgeon. In his all-round quality only one surgeon is said to have surpassed him, the great John Hunter. He was an able diagnostician, a practical discoverer—amongst other things inventing the substance now known as mackintosh—a good

writer, and a brilliant teacher. His fame as a teacher was as great as his fame as a surgeon, and his classes were more crowded than any in the kingdom.

In his private character Syme naturally exhibited the same qualities as made him a great surgeon. In all things he was essentially a man of power. He was the host and friend in his home and the warrior without. He was large-hearted, hospitable, and upright, staunch as a friend and as a fighter in defence of his friends and what he held to be right. He was a doughty opponent, and the ablest men of his day hesitated in controversy if they thought James Syme might take the field against them. His generosity enabled him to recognize and acknowledge the work of younger men, a quality by no means common amongst men of fame and experienced years, and as a consequence he always had a devoted following from amongst the younger generations.

Lister was sent by Sharpey to see Syme in 1852, when the latter was at the height of his fame. The visit was not intended to be a lasting one, but as often happens when great natures meet, mutual attraction was immediately felt. Syme, with his strong face, the broad, practical forehead, the firm nose, and the large, generous but rather pugnacious mouth, was attracted to the young surgeon with the calm, meditative face and lofty brow, and the young man quickly learned to revere and love the great surgeon.

It was arranged that Lister, instead of returning to London, should stay in the Scotch capital and become Syme's house-surgeon in the Edinburgh Infirmary, an arrangement that eventually extended Lister's temporary visit to the north to a period of twenty-five years.

The hospitality of "Millbank," Syme's beautiful home on the outskirts of Edinburgh, was thrown open to him. The gatherings at "Millbank" were not large, but guests were welcomed with great warmth of heart. In addition to Syme, the family was formed by his second wife, his three children by her, and his two daughters, Agnes and Lucy, by his previous marriage. With Agnes young Lister fell in love, and his affection was returned. They became engaged, and on April 23, 1856, were married at "Millbank." Up to the time of his marriage Lister adhered to the Society of Friends, but upon his marriage he decided to join the denomination of his wife and became a member of the Church of England. He "married out" according to the phrase of the Quakers.

The union was childless, and it seems a grave misfortune that Lister and his wife had no child in view of the fine quality there was on either side. But if the union was childless, in all else it was most happy. Their marriage, said a friend of them both, "was a lifelong honeymoon." From the first Agnes Lister was the mother of her husband's labour and of its fruits. As Herschel's faithful sister sat by her brother's

side hour after hour and carefully noted down what he observed, so Agnes sat by her husband's side and took down the accounts he gave her of his observations. These notes, written in her close handwriting, bear testimony to many a quiet hour of mutual work and mutual affection.

These days of early marriage were the happiest of Lister's happy life. The shyness and restraint which he always felt with those with whom he was not intimate wore off now that he had his own home in Edinburgh. He now felt free to display amongst his friends the boyishness which he preserved and carried into maturer years, a characteristic of constructive genius, which does not seem to be limited by age but early possesses the gravity of years, but at times of recreation and joy never loses the fresh gaiety of childhood. Not that Lister previous to his marriage had been lacking in high spirits. He joined his friends in the usual adventures of student life; on one occasion sallying forth to take down the flaunting wooden board of a quack doctor and returning to burn it with ceremony before the Infirmary; on another climbing "Cat's Nick," being precipitated with his friends to the bottom, and when borne back disabled to the infirmary, receiving the greeting from Mrs. Porter, Syme's famous nurse, "I aye kent something would happen wi' you Englishmen whustlin' on the Sabbath day." But with his marriage his happiness became a permanent factor of his life and his daily possession.

Lister and his wife set up house in No. 11, Rutland Street, a street opening out of the western end of Princes Street. Besides entertaining their friends at their own house, the young couple met at "Millbank" Dr. John Brown, Robert and David Christison and other well-known or coming men, and not infrequently foreign surgeons of distinction who came to see Syme's work. The evenings were spent in a family manner, with games, conversation, and music. Lister, who was fond of music and had a good voice, used to sing Scotch songs, his favourite being "Jock o' Hazeldean." But he was in no way a musician and probably never went of his own free will to a concert in his life. Nor had the theatre attractions for him. He had within himself ample entertainment, and divided his time between his work in the world and the pleasures of his home.

Lister acted as Syme's house-surgeon up to 1855, and gathered knowledge and was inspired by the example of his chief. There are several accounts of the daring operations which Syme successfully undertook with the help of his house-surgeon. The effect of these operations upon the junior participant were permanent and fructifying. There are, indeed, few things more encouraging to aspiring youth than a strong and talented master, few things more dispiriting than a pretentious and timorous one. Lister saw surgery under the best aspects, and to his trained mind the daring and success of one of Syme's

most historic operations must have vividly shown that enthusiasm and practice could only be welded together by boldness and decision if they are to achieve supreme success. The occasion was the cure of an aneurism, a condition which holds over the sufferer the probability of an unheralded and immediate death from sudden hæmorrhage.

The case was one of those dramas in which a doctor frequently plays a decisive part. In a brawl a young man had been stabbed in the neck by his enemy. The knife had wounded but not severed one of the carotid arteries which run up on either side of the neck to supply the head and brain with blood. As a result the blood was leaking into the muscles and tissues round and about the artery. In such cases the blood-leakage may suddenly become acute and the patient bleed quickly to death into his own tissues. In this case another fatal sequel was occurring. The blood was slowly collecting round the youth's windpipe and as slowly throttling him to death. In the event of death his assailant would be deemed a murderer and be hanged. Two lives, then, depended upon the slow, progressive leakage from the wounded artery.

The wounded youth was brought to Syme, and he, in spite of the extreme danger of the operation, decided to attempt by his skill to save both the patient and his assailant. Lister assisted him at the operation. Well-known sur-

geons gathered round to watch him and students crowded into the theatre. There was that hushed but eager agitation that precedes a daring venture against death. Syme and his assistants got ready. The patient was put under chloroform. Doctors and students craned forward for a view. On every face there was written the anxiety and dread which leavens all curiosity. Only Syme himself looked cool and unconcerned. Lister was already beginning to perspire, his usual habit at an operation. The patient was "under," the anæsthetist told the surgeon. The patient's shoulders were elevated, and the neck pulled back. Syme and Lister prepared themselves to be instant in execution. Everything was ready—the knife, the aneurism needle, the sponges. The blood-vessel Syme had to cut into is one of the largest in the body. A few seconds of blood-rush from it and all is over. Next to it lies the big jugular vein of the neck. Nature has protected them with rib and collar-bone. They are hard to get at, and the oozing blood had embedded them in a semi-liquid mass, pushed them aside and confused the few leading marks in this small and bone-encased corner of the body. Syme took the knife and deliberately traced a long line, dividing the skin. The knife was followed by welling blood. Syme then cut swiftly towards the injured artery. Only he and Lister could see. The others attempted to see. All they saw was gouts of blood spouting and welling from the wound, and the surgeon's and

assistant's quick fingers at work. What was happening they could not tell. Only the blood poured out. A few moments and it must have been over. The difficulties were tremendous. Syme declared later that they were almost insurmountable ; he could not think about them without a shudder of horror. But it was no time for horror now, but only for rapid, decisive work. The patient's face was ghastly in its whiteness. Syme's fingers dipped into the wound, a blunt needle armed with a piece of silk followed them, something was done in the small and deep cavity. More blood gushed forth. The spectators felt a gasping dread that in a moment the final, horrible grey pallor would come over the face they watched. But Syme and Lister were still cool, though Lister's face was bathed in perspiration as if he had been running a race. Again the fingers dipped in and were followed by the loaded needle. They were withdrawn. Syme leaned back a little from the wound and took a deeper breath. The spectators saw that the wound was dry, the blood no longer spouted and welled from it. Syme had succeeded. The patient was removed. It was too wonderful. All in the still and silent theatre broke out into a prolonged hurrah.

Lister, as has been said, acquired the greatest admiration for Syme. " I was fascinated by his rare diagnostic power and his surpassing powers as an operator," he said. His father and Sharpey had fixed his love for microscopical research, his

father-in-law bound it to the practical aspect of surgery. Upon these two pedestals he firmly took his stand and became the Colossus of surgery, beneath whose mighty form we pettier mortals betake ourselves to the art of healing and sail forth from our haven of studentship.

So well did Syme and Lister suit each other that Lister was given "the unexpected great privilege of a second house-surgeoncy." This appointment lasted until 1855. But the connection was not then severed. Lister was appointed assistant surgeon to the infirmary, retaining his connection with Syme and the wards over which the latter ruled. He was also made a Lecturer in Surgery, the course of lectures which he gave qualifying students for the examinations of the University and College of Surgeons.

Lister was now in a position of authority, but he also had more leisure. Whilst Syme's house-surgeon he had been absorbed by the practice of surgery, and though he had not abandoned the use of the microscope, he had used it mainly to help him in the diagnosis of cases under his care. Now he began once more to attack the problems that provoked him at University College Hospital. At the latter hospital he had searched for fungous bodies as the possible causes of the terrible form of blood-poisoning known as "hospital gangrene." This and other forms of blood-poisoning demanded their toll of agony and death at the Edinburgh Infirmary. In London Lister tried forthwith to discover the causes of these

diseases. With his riper experience at Edinburgh he began slower and more momentous labours. He laid siege to his problem and no longer trusted to a sudden and happy assault.

He began to investigate the nature of inflammation as the first step to the solution of the mystery of the putrefaction of the blood which resulted from inflamed wounds. His zeal proved infectious, as it is peculiarly liable to do at a medical school amongst students and young graduates concerned with knowledge and as yet unaffected by the need and desire for money. Lister's personal humility and obvious sincerity freed his enthusiasm from any suspicion of arrogance and assertive dominance. Students and young graduates were only too anxious to help him. In abattoirs, in the Veterinary College, in Lister's private house, observations were made and experiments carried out. His tirelessness, the tirelessness that is ever refreshed by the knowledge of its object, sometimes exhausted the volunteers, who were less able than Lister to calculate and weigh the importance of certain experiments and the need of their immediate completion. The late Professor Annandale, one of his helpers, thus recalled his experience: "I confess that on more than one occasion our patience was a little tried by the long hours we were thus engaged, and more particularly when the dinner hour was many hours overdue, but no one could work with Mr. Lister without imbibing some of his enthusiasm." One thinks again of Herschel, working at his

mirror for hour after hour with insuperable patience, whilst his sister put food into his mouth.

Lister and his assistants were amply repaid by the results of their work.

The subject of inflammation was beset with difficulties and confusion, a number of theories having gathered about it, as clouds gather about a mountain peak. Lister by his beautiful experiments and intuition swept the clouds of misunderstanding away and made the problem lucidly reveal itself.

The explanation that he gave may sound simple and natural to the lay reader. It is right that it should seem so, for it was both simple and natural. It is one of the duties and signs of genius to reduce the complicated to the simple and resolve the fantastical in the natural.

Every one knows what happens in inflammation; if not, a very simple experiment will show him. Let him touch his skin with some irritant such as a glowing match-head. At the moment of the touching the skin will be seen to go white, but it will quickly become pink or red, and even if the burn is a very moderate one some redness will remain which cannot be pressed away. If the burn is an unintentional and serious one, blisters will follow and will discharge a clear fluid, and finally in a few days suppuration will take place, matter will be discharged, and some fever and other signs of blood-poisoning will occur, especially if any "dirt" has got into the wound.

Such is the course of inflammation as presented to the eye. Lister's first problem was to discover the how and why of it, or at least to reduce the problem to its first principles and simplest terms.

The question was one of the highest philosophic importance. One may, in fact, state that though this question did not and does not loom large in the public eye, though it did not and has not aroused anything approaching to the sensation caused by Darwin's hypothesis, by the theory of evolution and the apish ancestry of man, their lies secreted in it truths of far greater moment to the fate and happiness of mankind. It ushered in the direct study of the condition described by the name of "vitality," and, turning from the endless and apparently hopeless study of the metaphysics of the mind or ψῡχή, initiated the very hopeful study of the metaphysics of the body. At first, of course, the full significance of Lister's work and aim did not occur to him and his helpers, nor have we yet realized it; but the astonishing transfer of power from the priest to the physician and the foreshowing of the physician-priest that has occurred in the last decades, may in the end prove to be the unique and outstanding feature of the latter part of the nineteenth and earlier part of the twentieth centuries.

Lister carried out his experiments at abattoirs and in his own home upon various animals either after they were dead or when they were chloroformed, or, in the case of the frog, when it had

been deprived of sensation by being "pithed." Sheep, horses, oxen, rabbits, cats, bats, and frogs were the subjects of his experiments, but not in any great numbers as the somewhat formidable catalogue seems to show. Of the edible animals far more were killed during his lifetime for his consumption than by his experiments, and in the former case by men much less gentle in their feeling for animals than he. Without these experiments he would never have been led to his discoveries. Vivisection, he averred before the Royal Commission upon vivisection which sat in 1876, had been essential to him.

He found, by watching with the naked eye and the microscope, that what happened after something irritating had been applied to living tissues which did not kill them outright was: Firstly the blood-vessels contracted and their lumen became very small; the part became pale. Secondly, the vessels after an interval, dilated; the part became red. Thirdly, some of the blood in the most injured blood-vessels slowed down in its flow and coagulated; redness occurred which, being solid, could not be pressed away. Lastly, the fluid of the blood passed through the vessel walls and formed a "blister" about the seat of injury.

Why and how did the vessels contract and dilate? Lister here made use of the work he had carried out upon the iris of the eye and the phenomenon of goose-skin when he was at University College. He found

that each tiny artery was surrounded by a muscle similar to that in the iris of the eye, which enables it to contract and dilate. He found further that this contraction and dilation was not an individual act on its part, but was an act dictated to it by the nervous cells in the spinal cord, the agents of van Helmont's central archæus.[1] As a consequence the flush of redness was not strictly localized to the seat of irritation, but would spread over a much larger area, as any one with a bloodshot eye, due to a piece of embedded grit, knows.

Having proved by a series of beautiful experiments and arguments drawn from them the nature of the inflammatory pallor and subsequent flush, and shown them to be dependent upon the central archæus in the nervous system, Lister then set himself to solve or refer back to its first sources the coagulation of the blood that occurred in injured vessels. The experiments by which he solved this problem are yet more fascinating and ingenious than the first series, and his accounts of them form some of the few delightful essays in the dry literature of medical research.

He did not merely solve the problem *per se*, but he showed that its first principle was the same that accounted for a number of other phenomena. He found that the clotting of the blood resulted from a direct and local loss of the vitality of the cells forming the inner lining of the blood-vessel. He traced it directly to the quality of the life or

[1] See Introduction.

vitality they possessed, the condition of the local archæus of van Helmont. This result, expressed in a popular word such as "debility," which is now taking the popular place of "acidity," "loss of tone," etc., of the chemists and mechanists, may appear to be an anticlimax. But it is not so; for scientists, like metaphysicians, theologians, philosophers, and also the man in the street, are perpetually getting away from that final cause and measure of things, the quality of the life or living thing expressed in the term "vitality."

Lister's genius preserved him from all stumbling. The frog, as many know, has the power of becoming dark in a dark place and light in a light place, changing the diffusion of the pigment in its skin, which makes it dark, to a concentration, which makes it light, with a facility that rivals that of the more famous chameleon. Lister for many an hour watched these changes with his microscope in the thin web of a frog's foot. He found by various experiments that this movement of pigment in the deep layers of the frog's skin depended not only upon the nerves or central archæus, but also upon the local. If he irritated or injured the pigmented skin, it lost its vital power for a longer or shorter period, being unable in this paralysed condition to change its hue. For the time being, as it were, the shadow of death had fallen upon the injured web.

Lister showed how the pigment itself possessed the vital capacity of moving to and fro to effect

the change of hue which, by making the frog of the same hue as his surroundings, conceals that defenceless animal from his enemies; and he showed that a great number of different substances, when applied to the skin, brought about the same local paralysis, evidenced by the pigment remaining still under the microscope. Lister then went on to show how the delicate and continuous movement of the minute hairs, or cilia, which coat the frog's tongue was also paralysed, either temporarily or permanently, by the application of irritants.

Armed with these and other proofs of the fundamental importance of the degree of vitality of the individual cells which collectively form the tissues and organs of a living creature, Lister showed that the clotting of the blood which precedes suppuration and gangrene was due to an actual loss of vitality of the inner cells of the blood-vessel. He showed in the most convincing and beautiful manner that the blood did not clot when in contact with living cells in a good state of vitality, whether it coursed through the blood-vessels or was kept still in them by ligatures tied round an artery or lay free amidst living and uninjured tissues. In the several phenomena of the clotting of the blood, the paralysis of the pigment in a frog's skin and the cilia coating its tongue, Lister saw primarily the same loss of local vitality. He had reached a first principle unencumbered or obscured by the hypotheses, facts, and pseudo-facts of the chemical and

mechanical theorists. He saw, as he put it in his own words, "the operation of the mysterious but potent forces peculiar to the tissues of living beings, forces which I suspect will never be fully comprehended by man in the present state of existence, and the study of which should always be approached with reverence and humility." It mattered not what animal or what tissue was attacked, or by what irritant it was attacked. Lister used "mechanical violence, the galvanic shock, desiccation of the tissues, dry heat, warm water at 100° Fahr., intense cold, caustic ammonia, a strong solution of common salt, carbonic acid, acetic acid, tincture of iodine, chloroform, oil of turpentine, mustard, tincture of cantharides, and croton-oil." In all cases a temporary or permanent loss of vitality of the irritated tissues resulted, evidenced by their loss of function. Disease—that is to say, paralysis of the cells, as the shadow of death—or death itself resulted. The paralysis, moreover, was due in each case to local injury, the paralysis of the local archæus, and had nothing to do with the nervous system, for it also happened when the nervous system was separated from the tissues by cutting through the nerves. "It appears," said Lister in a paper read before the Royal Society in 1857, "that the various physical and chemical agents which, when operating powerfully, extinguish the life of the constituents of the animal body, produce by a somewhat gentler action a condition bordering upon the loss of

vitality, but quite distinct from it, in which the tissues are, for the time being, incapacitated for discharging their wonted offices, though retaining the faculty of returning afterwards, by virtue of their own inherent powers, to their former state of activity, provided the irritation has not been too severe or too protracted. This suspension of function or temporary abolition of vital energy is the primary lesion in inflammatory congestion."

One sees in this description of the philosophy of inflammation upon a small scale a description applying to disease upon a large scale, in which sufferers are "for the time being incapacitated for discharging their wonted offices." One sees that the question of disease in the great class of inflammatory disease at least becomes initially a question of a paralysed vitality. A continuation of such paralysis meant death. Inflammatory symptoms were the signs of bodily resistance to the irritant with promise of recovery. The irritants of which Lister made use in his experiments were all dead substances; the attacks upon vitality were artificial. How would it be if a living, minute, microbic enemy were discovered, whose attacks would vary, as everything that is living varies, and sometimes be long and protracted, sometimes suddenly fierce, sometimes slow but with outbreaks of ferocity? What vicissitudes, what drama would be added, were the watching of artificial battles replaced by an outlook upon real warfare between antagonistic life? What vistas of new understanding would open

out of this microscopical warfare with the initial paralysis passing on to death or to a resistance of the tissues as evidenced by inflammation, a warfare which is so vital to man! What new weapons would be forged, what new defences erected, what new strategy and tactics devised! One general at least was ripe, and probably only one, for these new discoveries. He had himself revealed and seen the process of this warfare in artifice, its local effects and tactics and their differentiation from the central strategy. He was versed in it as no other was versed in it. Through long hours of experiment and the patient watching of affronted Nature, he had become master of the signs of her affliction. The disclosure of the living enemy would change artifice to reality, and transfer the stage of Lister's generalship from the laboratory to the living world of men.

It is the ability of genius that rescues "petty mortals" from the labyrinth of confusion in which they involve themselves in attempting to solve or even to find a safe path through the mysteries and difficulties of life. Genius makes the tortuous path straight and the complex simple. Lister made the problem of inflammation seem simple enough. He placed it on a par with the ordinary experiences of life, such as the unexpected attack of an enemy upon the vitality of a country. But the problem was by no means simple before he made it his own. Scientists are apt to be thought by laymen to be

folk who proceed by the direct proof of experimentation, and who never deviate from this safe guide. Nevertheless, in one sense at least, the processes of science differ little from other human processes. They and their results and effects upon the sum of human happiness and power ultimately depend on the unerring aim of genius at the vital centre of all problems. Scientists are as apt as other men to get involved in confusion and redundancy. Any one versed in the science of the present day, and especially in sciences such as psychology, which as yet has produced no genius, can have little doubt of this. Theories come and go, facts are scarcely established before they are disproved or "qualified," speculations and fantasies breed rapidly to a general confusion. A law is scarcely formed before it is found to fail. As a result of the enthusiastic energy of more ordinary men, uncontrolled and unchecked by genius, problems become overgrown, shapeless, and unwieldy. Then the hand of genius appears and gives shape to the shapeless, and out of the chaos brings form and understanding. Science, the product of great numbers of ordinary men or men of talent without genius, is to-day in its principles and fundamental thought cumbersome, complicated, and confused. But in this matter of inflammation and the reaction of living tissue to attack there is clarity and definiteness, and this clarity is due to the masterly vision of Lister.

Such being the case, it cannot surprise one that

sometimes genius becomes impatient of the well-meaning but ill-directed efforts of lesser men, or scornful of the lack of vision by which they miss altogether the obvious that seems to stand in their path. Lister himself, though gentle and patient to a rare degree, sometimes gives evidence of this scorn, which in his case, perhaps, was more in the nature of surprise, for he was one who had a faith in man's efficiency and devout truthfulness not altogether warranted. "It may appear almost incredible," he wrote in one of his papers of this period, "that a fact of such fundamental importance, and at the same time so easy of demonstration should have escaped the observation of all the eminent men who have made the coagulation of the blood a subject of special study"; and again: "This remarkable phenomenon, though of itself clear proof of an alteration in the properties of the blood in an irritated part, has, strangely enough, attracted little attention from other observers." But such expressions of impatience or surprise are rare in his papers. They are infused rather by a noble reverence for his subject and a profound meditation upon the secrets that lie hid in phenomena we deem to be familiar, the blush that follows a blow and the lasting stain of a bruise.

A photo of him taken at this time, when he was about thirty years of age, repeats the character of his writing. He is sitting upon a chair, his knees crossed, his arms folded, his

face in three-quarter profile. The attitude is one in which the limbs are composed so that the thought may be free. The face of Lister is eminently one of thought. The features are refined and gentle, the eyes quietly contemplative, without any of the fire of the fanatic. It is the brow that is most impressive. It is both broad and high, overhanging the eyes with its dome of thought. It is smooth and without line, and gives to the calm face the serenity of a noble meditation, that is not vexed by ambition or fretted by resentment. It is, indeed, a face such as the people of the Orient deem has sacred quality within it, in the serene mastery and calm which appears to them the summit of man's attainment.

At the end of 1859 Mr. James Lawrie, the Professor of Clinical Surgery in the University of Glasgow, died. In February, 1860, Lister, owing to his own merit and the strong advocacy of his father-in-law, was appointed to be his successor. In the same year he was made a Fellow of the Royal Society for his work upon inflammation. He was thirty-three years of age at the time.

The position of Professor of Surgery at Glasgow was peculiar. It did not carry with it an appointment as surgeon to the Glasgow Infirmary, which was separate from the University. The allotment of surgical wards to the care of the Professor of Surgery depended upon the goodwill of the directors of the infirmary.

In Lister's case the directors proceeded with the caution for which Scotchmen are famed. They spent a year ruminating upon the merits and demerits of the young professor. The honour which the Royal Society had paid to him and a petition signed by a large number of students crystallized their decision. After a delay of twelve months they appointed to their hospital the young surgeon who was destined to make its wards the scene of one of the greatest triumphs of mankind.

The surgical wards of the Glasgow Infirmary at this time were hotbeds of pollution and disease. But in this they did not differ from those of other hospitals, as the next chapter will disclose.

CHAPTER III

THE DEFEAT OF CHARITY

THE charity of men within the records of history has always made some provision for the sick. In Greece and Egypt the temples of the gods were also places of refuge for the sick, and, in addition to these sacred and therapeutical resorts, physicians were publicly appointed to attend to the poor.

The first widespread hospital system—not only for men but for animals also—which is comparable to the modern system was established by King Asoka (260 B.C.), the famous Buddhist sovereign of India.

The Romans followed the example of the Greeks and appointed public physicians and dispensaries. Christianity, like Buddhism, inspired charity with increased fervour, and hospitals spread over the Christianized Roman Empire. These institutions were, however, more ecclesiastical than medical; the clergy and the charitable of the congregation figured importantly, and the physician and student of medicine were of no account. Thus a law of the Emperor Honorius mentions six hundred nurses who were placed, not

at the disposal of the physicians but of the bishop, for the care of the sick in the hospitals at Alexandria.

The followers of Mohammed established in their empire far more efficient hospitals, in which the sick were housed and nursed, and were attended gratuitously by physicians who themselves had students under their charge. Bagdad, Damascus, Jerusalem, Cairo, Alexandria, Cordova, all the cities of the Arabian Empire possessed well-equipped hospitals under the control of expert physicians. In Bagdad, in the twelfth century, there were no less than sixty salaried physicians upon the staffs of the city hospitals.

The efficiency of the Mohammedan medical charities began to shame the ecclesiastical charities of the Christians. The crusaders brought back stories of the magnificence of the hospitals of the East and the skilful treatment of their physicians which they had themselves experienced. Travellers from Spain brought the same tales. For a time Christendom was stimulated to more proper efforts, and the physician and his worldly art gained some respect.

But as the Arabian influence died away, the Christian hospitals, whose inefficiency was undeniable, became again neglected. Funds were misappropriated, buildings fell into decay, and though benevolence did what it could, the prevailing reverence for the priest and the contempt of the physician who attended to the despised body prevented a capable service.

The Defeat of Charity

It was in 1574, in the starved and battered city of Leyden, that the medical art once more regained respect. There, after the fiercest siege in modern history, the forces of Protestantism for the first time clearly triumphed over those of Catholicism, and to crown the triumph the University of Leyden was founded. Professors were nominated, amidst whom those of the medical faculty took an honourable place. On the day of the opening ceremony, upon February 5, 1575, symbolic figures were drawn through the flower-strewn streets of the recovering city. There were four groups: the Gospel, Justice, Medicine, and Minerva. With the Goddess of Medicine rode Hippocrates, Galen, and other physicians. With Minerva rode Aristotle, Plato, Cicero, and Virgil. Once more knowledge was united to the charity of the gospel. Apollo and the nine Muses enthroned awaited the professors and embraced them each in turn. The procession then marched to the cloister of St. Barbara, converted into the University of Leyden, and there the blessing of God was called down to give power to the rebirth of knowledge.

But many years passed before the religious struggles of the Reformation died down and enabled men to pay heed to the new schools of learning and hospitals. In Catholic countries the priests still ruled over hospitals and the orphanages and almshouses connected with them.

The notes of John Howard the philanthropist, who wrote in 1789, give a picture of the

European hospitals of his time. They were mostly very crowded and at times of epidemic sickness the crowding was terrible. In the Hôtel Dieu in Paris, for example, there were 1,200 beds and an average of 3,000 patients, the number at times of epidemic mounting to 7,000. There were two patients in one bed, and often more. Medical and surgical sufferers were mixed together, a man with a broken leg being in bed with a man with fever, or a convalescent and a dying man side by side. Windows were kept closed, fresh air being regarded as dangerous. "The wards were often so offensive," wrote Howard, "as to create the necessity of perfuming them; and yet I observed that the physician, in going his rounds, was obliged to keep his handkerchief to his nose." Of the British hospitals Howard gave a better account, though he had no praise for the Edinburgh Infirmary. The London hospitals, he complained, were actually too free from ecclesiastical influence, for he "never found any clergyman administering consolation and admonition to the sick."

The sickening odour of the wards of hospitals, of which Howard complained, continued to exist up to the days of Lister. There was, said Sir Hector Cameron, Lister's house-surgeon in the Glasgow Infirmary, "in the atmosphere of every surgical ward, no matter how well ventilated, a fœtid, sickening odour, which tried the student on his first introduction to surgical work just

as much as the unaccustomed sight of the operating theatre."

What, then, was it which made these pre-Lister hospitals such offensive places that only perfume could deceive the sense of smell as to the horrors which only the eyes of familiarity could witness without shuddering? What was it that made the wounds and injuries of men, women, and children under the tendence of charity so incomparably more loathsome than the wounds of animals and less civilized men, so that it not only seemed but actually was the case that the charity of man was defeated and turned into a source of untold agony and suffering?

The subject is a gruesome one, but it is indispensable in order that the work of Lister may be properly illuminated. It is indispensable also as one of the most dramatic lessons of the danger of charity without understanding, of the tender heart without the governing mind.

Sir Hector Cameron gave the following brief description of the days when Lister first went to Glasgow: "Every wound discharged pus freely, and putrefactive changes occurred in the discharges of all"; and again: "Secondary hæmorrhage, tetanus, erysipelas, septicæmia, pyæmia, and hospital gangrene were never all absent from the hospital wards, and at times pyæmia and hospital gangrene became alarmingly epidemic." The list of technical names can scarcely convey to the mind of the reader the repulsive horror and the sights of agony

which Lister so often witnessed and which stirred so profoundly his earnest and tender nature. In order to give an unadorned and unmodified account of the scenes that could be witnessed in a hospital in those days it is best to quote directly from the most famous textbook of surgery in the first half of the last century, " The Principles of Surgery," a series of discourses by John Bell, and re-edited by his brother, Sir Charles Bell.

Lister's first work in antisepsis was upon cases of compound fracture—that is to say, cases of broken bone in which the skin is also torn through either by the force of the injury or else by the sharp ends of the broken bone itself. The broken skin offers an opening through which " dirt," or infective germs, can enter and cause putrefaction and blood-poisoning.

A compound fracture nowadays is scarcely worse than a broken bone without torn skin, unless there is very great crushing and laceration of the bones and tissues. But in the days of John Bell and Lister's early years no accident could well be more serious if the patient had the misfortune to be taken to the hospital. He was better off in the gutter.

The wound in hospital invariably became infected. Infection was rife in the hospital. Every wound poured forth the infective poison, and by the congregation of many sick the poison became more concentrated and deadly. It would be folly to take a child suffering from an ordinary sore throat and put him in a hospital ward filled

with children sick with virulent diphtheria. It was a far greater folly, though an unconscious one, in those days to take a wounded man to hospital. The injury greatly lowered the vitality of the injured tissues, and in their paralysed condition they fell an easy prey to the virulent germs that haunted every surgical ward. Such wounds then always suffered from putrefaction. The following is John Bell's account. It is frankly horrible, and the reader of delicate nerve had better skip it and pass on to page 77.

The discourse was headed "Of the Stage of Suppuration," and continues :—

"Though you expect to procure adhesion, and at least to make some part of the wound adhere, you are often disappointed; you are sensible from the violence of the fever and the swelling of the limb that mischief is going on within. The dry skin, the parched mouth, the thumping pulse, the restlessness and delirium, continue for some days, and there is a blackness round the wound threatening gangrene. But this fever by degrees becomes less violent, the livor, which proceeded partly from the ecchymosis, partly from the dark colour of the inflammation, gradually changes to green, the great wound begins to suppurate and open very wide, the whole limb swells to an enormous degree, the skin and cellular substance are soft and relaxed, and bear the impression of the finger, the redness extends all over the limb, and from the particular hollowness and softness of certain points you are

sensible that great suppurations are forming within.

"All your prudence, and more especially all your diligence, is required for conducting this stage of the disease. You are careful to dress the limb every morning, and perhaps to clean it a little in the evening. By regular washings and wiping with the moist sponge you prevent those smells which depress the patient's spirits and injure his health, and by laying clean lint to the wounds twice a day you soak up the foul matter. . . . How much is due to care and cleanliness" (really, "how dangerous were the hospitals") "you may judge from this, that in the case of a gentleman who lies in his own house we often venture to save a limb which had the accident befallen a poor man lying in a crowded hospital, must have been cut off. In hospitals, especially in military hospitals, and most of all in hospital ships (which the Lords of the Admiralty would do well to burn), the patient sinks almost inevitably under the suppuration of a compound fracture.

"Often it happens, from the destruction of the parts or the unhappy circumstances of the patient, that all your cares are unavailing. Every time you examine the limb you make discoveries of more extensive destruction, you find the whole limb swelling more and more, you find the matter running profusely from the openings, the openings increasing in number, and the suppurations extending from the ham to the heel with intoler-

able fœtor, the muscles all undermined, and the bones carious. You find that you are no longer able to support the patient's health, that repeated attacks of diarrhœa and fever have reduced him to extreme weakness; and the wan visage, the pale and flabby flesh, the hollow eyes and the prominent cheekbones, the staring and squalid hair, the long, bony fingers and crooked nails, the quick, short breathing, and small piping voice, declare the last stage of hectic and debility; the natural powers are then sunk so low, the appetite for food and even the desire of life so entirely gone, that we would believe the patient past all help did we not know by experience that it is never almost too late to amputate."

But an amputation always meant renewed suppuration, against which the wearied and emaciated patient made little or no fight. Even if he recovered without an amputation, "he is lame and walks on a stilt, and his natural constitution has received an irreparable shock"; from the state of a healthy man he falls "to the state of a valetudinarian, dispirited and dejected, travelling now the downhill way of life: he has lost his health and saved a limb, which he drags after him with labour and pain."

It is not surprising, then, in face of this terrible suppuration following upon compound fracture that John Bell and the surgeons of his time recommended the lesser suppurative sickness following amputation to such unfortunates,

although this included the operation without chloroform, in which the patient was bound down to the table, whilst with his senses keenly alert his limb was swiftly severed from him. But even after the amputation had been performed the chance of the patient getting out of the hospital alive was little more than an even one. Further suppuration, crippling his health, he was bound to endure.

A more dread foe awaited him or any unfortunate who found himself with a wound or had to have an operation in a surgical hospital. He might fall a victim to that ghastly disease which, abolished by Lister, was previously known as " hospital gangrene." There were other forms of blood-poisoning as fatal, but none possessed the peculiar horror of this disease.

John Bell, in Discourse III, wrote :—

" There is no hospital, however small, airy, or well regulated, where this epidemic ulcer is not found at times ; and then no operation dare be performed, every cure stands still, every wound becomes a sore, and every sore is apt to run into gangrene ; but in great hospitals especially it prevails at all times, and is a real gangrene ; it had been named the ' hospital gangrene ' ; and such were its ravages in the Hôtel Dieu of Paris (that great storehouse of corruption and disease) that the surgeons did not dare to call it by its true name ; they called it the rottenness, foulness, and sloughing of the sore ; the word ' hospital gangrene ' they durst not pronounce,

for it sounded like a death-knell ; at the hearing of that ominous word the patients gave themselves up for lost. In the Hôtel Dieu this gangrene raged without intermission for two hundred years, till, of late, under the new Government of France, the hospital has been reformed. ' A young surgeon ' (says an ancient French author) ' who is bred in the Hôtel Dieu may learn the various forms of incisions, operations, too, and the manner of dressing wounds ; but the way of curing wounds he cannot learn. Every patient he takes in hand (do what he will) must die of gangrene.' "

John Bell went on to describe this disease in some sailors under his own care :—

" While these ulcers made their dreadful progress in any of the wounded I could observe them pass through the several stages—first of inflammation, then of insensibility and gangrene, and then of renewed pain and sensibility. First, when the health is affected, the patient has shiverings, languishes for a few days, and the sore inflames ; then comes vomiting, diarrhœa, and a distinct fever, and the disease seizes plainly on the wounded part. In its first stage the wound swells, the skin retracts, wastes, has a dark erysipelatous redness verging to black, the cellular membrane under the skin is melted down into a fœtid mucus, and the fascia is exposed. But in the second stage the fascia and skin, unable to bear their inflammation and deprived of mutual support, become black, fœtid, soft,

and fall into perfect gangrene ; yet there are no vesicles, and the mortification is confined within the cavity of the sore. This is the stage of insensibility ; the parts within are covered and defended with a perfect slough, which no medicine can penetrate, on which no applications can make any impression ; and stimulants are used, without pain, of such a hot and fiery nature as none but dead parts could resist. But when these sloughs open in the natural course of the disease, and the living parts are exposed, and the medicines begin to make an impression, it is imagined that these applications are restoring life and energy to parts which, before they were applied, seemed entirely dead ! It is under the impression that stimulants are continued of a strength which parts thus inflamed cannot bear ; the disease is aggravated by them, and the cries from all sides are such as would melt the most rugged nature.

" In the third stage this gangrene ceases, the sloughs fall off, the muscles become exposed, the part assumes once more the appearance of a common sore, but fearfully enlarged ; a high and glossy red and a smooth, shining, uninterrupted surface mark the continuance of the inflammation and disease ; but if the sores are to do well, it is known by a rough, granulating surface, somewhat dry and of a paler colour.

" If the patient is to die, the gangrene or wasting of the cellular sheath proceeds ; the skin

first sloughs off, then the fascia is destroyed; those divisions and lamellæ of the fascia which dive between the muscles to enclose, protect, and nourish them are next affected; the matter continues slimy and thick and in prodigious quantities; the muscles are divided from each other more and more. In many who suffered under the disease at the same time with Joiner (the boy above mentioned) you could have laid your hand edgeways betwixt the several muscles of the thigh. Then the vomiting, diarrhœa, and nervous symptoms increase, the pain is dreadful; the cries of the sufferers are the same in the night as in the daytime; they are exhausted in the course of a week and die: or if they survive, and the ulcers continue to eat down and disjoin the muscles, the great vessels are exposed and eroded and they bleed to death. Thus a lad of the name of Handling, who had at first but a slight wound in the thigh, had the cellular membrane in the course of a few days so destroyed that you could put your clenched fist into the hip and could lay the hand sideways betwixt any two muscles of the thigh. You could have counted each muscle as in a dissection, from the tuber ischii to the ham. The branches of the profunda femoris first gave way, then the sciatica vessels; for three nights he lost two or three pounds of blood each night; it would have been almost cruel to stop the hæmorrhage, had it been possible, so very desperate was his situation; on the fourth day he died. I hope

and believe that these scenes have made a lasting impression on the few who witnessed them.

"These are the forms which this disease assumes when it attacks an amputated stump: a broad and open wound, a laceration of the skin or any surface which is apt to become a flat sore. But when it attacks a narrow wound, as a bullet wound, a wound with any pointed instrument, even the prick of a nail in the finger, it assumes at once the form of an erysipelatous gangrene (erysipelas gangrenosa); and when this disease prevails in the hospital you may see even a nurse from some slight hurt in the hand, which at another time could have done no harm, have one day a swelling of the wound, on the next an erysipelas of the arm, with dreadful pain and low fever, on the third day the arm will become livid and covered with vesicles, and in two days more fall into gangrene, the woman oppressed in the meanwhile with hiccup, low delirium, and other symptoms of approaching death.

"The wounds which are most apt to be seized with this hospital gangrene are those which are flat and open, because in them much of the skin has been torn away. Tucker, a boy also belonging to the *Triumph*, who lay in the bed next to Joiner, had, like him, received a superficial and open wound, or a scratch rather, upon the loins from a splinter of wood. This dreadful infection seized upon his wound, and the ulcer extended over the loins, over both buttocks, and part of

both thighs; he could only lie on his belly, and, like Joiner, cried in the most lamentable manner."

John Bell continued with further pictures of this repulsive and cruel disease. Men, women, and children were turned by it into a foul but living putridity, until death at last got rid of the life that was a burden to itself and a source of offence and loathing to its neighbours. This was the worst disease of the many terrible diseases that were the gift of man's charity to man. It was the gift which the Hôtel Dieu, the House of God, dispensed to all who sought or were forced into its charitable wards, so that no less than twenty-five out of every hundred who entered living were borne out dead. In the great hospital at Munich at one time as many as eighty out of every hundred patients with wounds were seized with this dread pestilence. The houses of God and the great hospitals were lies and delusions, the traps of the destructive goodwill of the ignorant.

What was the remedy against this hideously deceptive charity?

John Bell continued:—

"What, then, is the surgeon to do? Is he to try experiments with ointments and plasters while the men are dying around him? Is he to seek for washes and dressings to cure such a disease as this? Is he to expend butts of wine contending, as it were, against the elements? No! Let him bear this always in mind, that no

dressings have ever been found to stop this ulcer, that no quantities of wine or bark which a man can bear have ever retarded this gangrene ; let him bear in mind that this is a hospital disease, that without the circle of the infected walls the men are safe ; let him, therefore, hurry them out of this house of death ; let him change the wards, let him take possession of some empty house and so carry his patients into good air ; let him lay them in a schoolroom, a church, on a dung-hill, or in a stable ; let him carry them anywhere but to their graves."

In 1846 the first operation under a general anæsthetic was performed in Boston Hospital, and the following year Sir James Simpson proved and used chloroform. The annihilation of the dreadful pain which made an operation such a gruesome thing in the past, and forbade any operations but those that were most urgent, opened out an apparently new era for surgery. But in hospitals the new blessing effected its own defeat. More operations were undertaken for lesser troubles, and the dread and terrible diseases of pyæmia and gangrene swept through the wards with redoubled fury.

Even outside the hospital, where conditions were all that wealth could provide, these deadly diseases sometimes effected an entrance, to the despair of the surgeon, and suppuration after large operations and in cases of large wounds and compound fracture was invariable. Here, too, if a patient escaped death, he was crippled

for life. The shadow of death that fell upon him was never wholly lifted.

Surgery was baulked and baffled, and hospitals, both for patients, nurses, and doctors, were places of living torment, which resounded with the cries of agony and polluted the air with the exhalation of rotting flesh.

It were better for a man to be placed " on a dunghill or in a stable " than let him remain in the house of charity that his fellow-men had provided for him.

CHAPTER IV

PERPLEXITY AND ENLIGHTENMENT

ONE of Lister's Edinburgh friends and a pupil of James Syme was Dr. John Brown, the gentle and melancholy author of "Rab and His Friends." In that well-known story Ailie, Rab's mistress, was operated upon. At first all went well, but on the fourth day the fatal blood-poisoning began—"a blush of red told the secret." Ailie became worse, and delirium set in. "Nothing more touching, or in a sense more strangely beautiful, did I ever witness. Her tremulous, rapid, affectionate, eager Scotch voice, the swift, aimless, bewildered mind, the baffled utterance, the bright and perilous eye; some wild words, some household cares, something for James, the names of the dead, Rab called rapidly and in a fremyt' voice."

Lister did not view the disease with this sentimental pathos. One thinks he must have read the book of his friend with strange feelings, for these ghastly sicknesses could not be varnished out of their horribleness by a too gentle heart, to which the delirium provoked seemed "strangely

beautiful." In Lister they aroused feelings of revolt rather than sentiment, and a rigid determination to overcome them, which was greater than his pity.

In Glasgow, in 1861, Lister for the first time had full command and responsibility in his wards. Glasgow was then as now a big manufacturing town with a large shipbuilding and shipping trade, with no great reputation for cleanliness but a considerable one for dirt and danger. Accidents were frequent in the shipping yards, and the men to whom these accidents happened were not the brawny sons of the moors and mountains, but the puny sons of the slums.

Lister also had come from the wards of James Syme, and that great surgeon by his care and cleanliness had succeeded, at least in part, in warding off hospital gangrene and pyæmia. But the wards of the Glasgow Infirmary did not show a similar firm hand. The dominant spirit was not that of the surgeon, but of the lay authorities. We have seen how slow and cautious the authorities had been in their appointment of Lister, and they continued to watch the young professor with a proper suspicion and to direct his ways. Economy of the narrowest kind was to them the light of reason, and a small bill for soap and scrubbing-brushes more commendable than cleanliness.

The spectacle, therefore, that met Lister in the wards put under his charge, though not unfamiliar, was one oppugnant to his sense of

fitness. The wards, though recently built, were dirty, and a general gloom hung about them as if their very appearance had partaken of the dark unhappiness they housed. The spectacle of the patients was yet more depressing. The unfortunate victims of the squalid alleys and factories of Glasgow, when injured or perforcedly submitting to operations, had few powers of resistance to diseases that often fought victoriously with the healthiest men. Blood-poisoning in the forms of pyæmia (blood-poisoning with multiple abscesses), hospital gangrene, erysipelas, and other fœtid diseases were rife. Thirty-nine out of every hundred men who had to submit to amputation died, and in addition to this terrible mortality those who recovered were frequently enfeebled for life.

To all surgeons and assistants such scenes were so common that they were met in a spirit of stoicism which men rightly assume to that which is inevitable. When outbreaks of gangrene were peculiarly malignant and every effort of the surgeon was finally trumped by death, then in resignation the surgeon would lay down his knife while the scourge endured and listen to the sympathetic assurances of his friends that he was not guilty of what fate inflicted.

Most fortunately, Lister, with the sense of power his comprehensive and directive intellect gave him, was not willing to submit. His feelings with regard to such absolute failure were original; they were not fashioned by friendly

consolation. He felt ashamed, he said, in drawing up his reports, that he had so frequently to record fatal results due to these diseases. He brooded constantly over their meaning and the possible causes that gave rise to them. He was utterly discontent with submission to their ravages. The thought of mastering them was ever with him and guided his actions, his observations, and inquiry. Why was it that when a limb was broken but the skin remained whole he could expect and promise to his patient a recovery without the horrors and dangers of suppuration? Why, on the other hand, when the skin was broken, should these impurities inevitably arise? He pondered over these things and pointed them out to his students as he went his rounds. "I cannot help thinking," he said after such a demonstration, "that the man who is able to explain this problem will gain for himself undying fame."

The test of greatness is not only the concentration of the mind upon some great and urgent problem, not only the whole absorption of self in this problem which is attacked without any ulterior motive than that of victory, but also the varied means by which the attack is made. Lister's mind was concentrated upon his subject. His desire to overcome his problem was free from any ulterior motive. He sought primarily neither fame nor remuneration through its possible solution, being quite free from the exploiting spirit. He sought only its solution, and brought

all the variety of thought, inquiry, and knowledge he could command.

His experiments in inflammation had altogether shaken his faith in such theories of putrefaction and suppuration as were then taught to students and believed by the profession. In reading surgical authors of the time one is chiefly struck by the lack of even such imagination as acknowledges that it does not know. One never comes across any author referring to the *mystery* of these diseases. Medical writers were as indifferent to these diseases as mysteries as they are to-day to the extraordinary decay of teeth, the mystery of the selective nature of memory, which plays so notable a part in many nervous and mental diseases, the increase of insanity, the difficulty of child-birth, the prevalence of appendicitis, the increased defectiveness of eyesight, and many other medical mysteries that are about us in these times. What Lister searched for in the profession—namely, any philosophic thought as to the causes of these diseases—he could not find. And the reason was that he could not find what was not there. They had no philosophy. Philosophy played no part in their curriculum. It played no part in their research work. It received no recognition from the profession; it receives none to-day. Even in Scotland, the home of British philosophy, there was no definite recognition of the extraordinary need of the philosophic mood, if medical problems are properly to be attacked and remedies rightly valued.

The mystery of these loathsome diseases had not even got to the stage of being a mystery and thereby challenging a solution. Only the philosophic temperament is not lulled by the familiar, but challenges it as if it were strange. This temperament Lister amongst surgeons of the day alone seemed to possess in a dominant degree. Sir Hector Cameron, in an admirable paper upon Lister read at Toronto in 1912, emphasized this philosophic possession of his Glasgow chief. He quoted from Cicero the words: "Instead of striving, as we ought, to render ourselves strange to the familiar, we strive, on the contrary, to render ourselves familiar with the strange." The question to me, however, does not seem to be one of "ought," but one of the natural differentiation between the genius of the mass of men; and it is for the nourishment and general acknowledgment of the rare capacity of genius, which by its quality has such unrivalled value, that a reverence for philosophy might prove of incalculable benefit to the medical profession.

However this may be, none will deny that Lister possessed the philosophic temperament in the highest degree. "I am sure," continued Sir Hector, "all those who have been closely associated with Lister and have watched the working of his mind will appreciate my statement when I say that, more than any man I ever met, he had the power of rendering himself 'strange to the familiar.' . . . I once said to him, when

we were talking of such matters, that I believed he had a rare power of making himself 'strange to the familiar.' He gave one of those pleased smiles which many of us knew when some remark was made which was not ungrateful to him; but he did not indicate to me whether he was conscious of possessing any such mental advantage."

"When he was told such a thing must be so," said Matthew Arnold of Goethe, "there is an immense authority and custom in favour of it being so—it has been held to be so for a thousand years," he answers with Olympian politeness, "But is it so? Is it so to me?" Lister was told, as a student and graduate, that putrefaction in wounds was due to the agency of the oxygen in the air. By the sole right of his genius he gravely questioned it and judged it by the measures of his own insight and power.

There were many points which served to excite Lister's thought as to the origin of septic diseases. John Bell pointed out how in some military hospitals, where few operations were performed, deaths were rare and these blood-poisoning diseases absent; in others, where operations were more frequent and the patients weak owing to prolonged exertions and unhealthy climates, these diseases raged. Lister's previous London chief, John Erichsen, illuminated the extraordinary character of pyæmia and serious blood-poisoning by stating that for twenty-five years his private practice had been exempt, but

amongst his hospital patients, who stayed for any time in hospital, the tale was very different, and a great number suffered.

But Lister could not find the clue to these striking differences. He set himself, however, to combat them in his wards by methods of indirect attack. His first method was the inauguration of a most rigorous cleanliness. In his work upon inflammation he had seen how the most varied substances had diminished or destroyed the local vitality of the tissues. He determined, therefore, to keep wounds, whether accidental or operative, as free from any dirt, foreign matter, or rough handling as possible.

It may seem strange that cleanliness should not have been a definite habit of surgeons, but, as a fact, there was no law of cleanliness in surgery in those days. The extreme cleanliness that now distinguishes the doctor is the outcome of Lister's discoveries and proof of the value of cleanliness. But before Lister the doctor paid no more heed to cleanliness than any other man. Indeed, he often paid less, for what would not be offensive to him owing to familiarity was offensive to other men. Before an operation the surgeon would turn up the sleeves of his coat to save the coat, and would often not trouble to wash his hands, knowing how stained they soon would be. The area of the operation would sometimes be washed with soap and water, but this was not invariable, for the inevitability of corruption made any elaboration of cleanliness

appear farcical. The silk or thread used for stitches and ligatures was hung over the button of the surgeon's coat, and during the operation a convenient place for the knife to rest was between his lips. The instruments were washed after the operation with soap and water and put away, but the instruments used for dressing wounds or lancing abscesses were kept in the vest pocket, and often only wiped upon a towel or a piece of rag as the surgeon or dresser moved from patient to patient.

A story of Sir Astley Cooper, the greatest surgeon of his day, will illustrate how careless even the most eminent doctors were in the matter of cleanliness. Sir Astley had to cut a wen from George IV's scalp, and suffered the usual apprehension lest erysipelas should set in in a magnified form owing to the exalted position and debased habits of his patient. On a day following the operation he was summoned to the palace. He hurried off in fear, and, though the King was not ill, Sir Astley noticed that the royal eye viewed him with considerable disfavour. On his return he asked his nephew if there were anything wrong with his appearance. "Why," replied his nephew, "I should have put on a white cravat and a clean shirt, or at least have washed my hands before I waited on his Majesty." Sir Astley's shirt and hands were bespattered with blood. "God bless me! so I ought," he replied, "but I was not aware of it—and the King, sir, is so very particular."

What a king's surgeon did not do by habit the rest of the profession were not likely to do ; and the professional hand, dealing not only with wounds and abscesses but sometimes with post-mortems, was particularly in need of soap and water. Lister introduced into his wards a scrupulous cleanliness. Dressers, nurses, and house-surgeons were made to wash their hands frequently when assisting at operations or dressing wounds. Abundant clean towels had to be provided. Frequent fresh, clean dressings were applied to suppurating wounds. Condy's fluid and other deodorant fluids were lavishly applied. The members of the lay committee expostulated at this extravagance in the cause of cleanliness.

But all Lister's efforts were without a marked effect upon the occurrence of blood-poisoning. It continued to rage, and Lister continued to look with horror upon its ravages and to ponder about a possible cause.

In his lectures to his students he insisted that wounds did not naturally pour out pus ; it was not inevitable. They did not do so when they were not irritated. But something caused the juices of the wound to decompose, and the acrid products of decomposition irritated the tissues and caused them to pour out pus. This " something " was something conveyed to the wounds. It was not the air, it was not the oxygen of the air, but it was probably something conveyed by the air, that something in the air of a surgical

ward which betrayed its presence by the fœtid smell.

Lister did not discover what this something was himself. But he was always upon the look-out for aid. He ranged through the English, French, and German literature, and his eye swiftly detected the key to his problem in the work of Louis Pasteur.

After Leeuwenhock's discovery of microbes in 1683 there was a lull for a century and a half in further discovery of the nature and importance of these minute beings. They were so excessively small that no man could handle them. There were a few speculations as to their nature, and even as to their possible relation to disease, but no work of any moment was undertaken or proofs advanced.

It was in a province of science outside that of medicine that the philosophic and fundamental importance of minute life was first proved. In 1836 Caignard Latour published experiments by which he claimed to prove that the minute specks which can be seen in yeast were alive. They budded and multiplied, and it was by their growth that the fermentation of beer was brought about. Theodor Schwann, the illustrious discoverer that man and animals are composed of hosts of minute cells, also came to the conclusion that yeast was alive, and that as a result of its growth sugar was changed into alcohol in the process known as fermentation. Both the Frenchman and the German, working independently, also took a wide

outlook upon the activities of micro-organisms in nature, and held that not only fermentation but also the putrefaction of vegetable and animal substances were due to them, that putrefaction was in fact a form of fermentation. The French botanist Turpin came forward and supported this view of putrefaction.

A view so powerfully advocated might have made progress had it not aroused to opposition the great Liebig, who resisted the new doctrine in a most strenuous manner. Fermentation was due to chemical substances, which he named ferments, he maintained. It had nothing whatever to do with living germs or micro-organisms. "As to the opinion which explains the putrefaction of animal substances by the presence of microscopic animalculæ, it may be compared to that of a child, who would explain the rapidity of the Rhine current by attributing it to the violent movement of the many millwheels at Mainz," he wrote. Helmholtz, who though but a youth was already known to science, undertook a series of experiments, as the result of which, though first supporting Schwann, he finally sided with Liebig. The matter was, then, considered settled, and it did not arise again for over a decade of years.

In 1854 Louis Pasteur, then thirty-two years old, was made Dean of the Faculté des Sciences at Lille. In 1856 M. Bigo, a local manufacturer at Lille, met with disappointment in the manufacture of beetroot alcohol. His son was

one of Pasteur's pupils, and on his recommendation the elder Bigo came to Pasteur for advice. The result was that Pasteur, who had already pondered the subject, began the series of investigations into the mysteries of fermentation and putrefaction which, though he was not a medical man, have had such a profound influence upon surgery and medicine.

In fermentation he proved finally that living organisms were the primary agents of fermentation. He repeated the observations of Latour, and watched the yeast-cells grow and multiply while the sugar turned to alcohol. He found organisms of another kind invariably present when milk was going sour in the common way with the production of lactic acid, the lactic-acid fermentation. He isolated some little grey masses of these organisms and, scattering them in fresh, boiled milk, saw the characteristic souring follow. He studied, with similar results, the form of fermentation known as butyric, which gives off the smell of rancid butter; and he found that by means of organisms he could produce lactic or butyric fermentations at will. Each organism, therefore, was specific in its result. It could produce one, and one form only, of fermentation.

Pasteur was not content with these final proofs of the dependence of fermentation upon minute life, variously known as micro-organisms, microbes, and germs. He determined once and for all to settle the outstanding question of the

spontaneous generation of life which the discoveries of the microscope had resurrected.

Scientists no longer believed that dead meat gave birth to flies or mutton gravy to so-called eels. The scornful laughter of Voltaire, who mocked at "men who denied a Creator and attributed to themselves the power of creating eels," had made them ashamed. But with the discovery of microbes the theory, abandoned in the case of eels and mutton gravy, was revived in the case of microscopic life.

M. Pouchet, a well-known scientist, with the help of his disciples, professed to prove that living organisms could come into being out of dead matter. There was no need of parent or parents. They sprang into life by the process of "spontaneous generation." A conjunction of the necessary elements from the surrounding organic matter and the new life was born. The creation of life was consequently a matter of daily occurrence.

Experimentation, said Pasteur, is not an easy art; it requires a combination of considerable natural gifts with long experience. Pasteur believed that Pouchet's results were due to faulty experimentation, and set out to refute them.

He prepared some flasks with putrescible liquid, which he boiled, and sealed the mouths of the flasks whilst the liquid was boiling. He set the flasks aside for observation. The organic putrescible matter was there; a conjunction of

the necessary elements of life could presumably take place and evidence itself in putrefaction of the fluid. It did not take place. There was not the slightest change, and on the flasks being broken open and the fluid microscopically examined no signs of germs or other life could be detected. Why not? Because, said Pasteur, the germs in the air were prevented from getting to it. He plugged a tube with cotton-wool and drew air through it. The cotton-wool became black with the dust which it filtered from the air. He added a fibre of the blackened wool to a flask. The liquid in it soon showed signs of putrefaction. Pasteur wrote to Pouchet. Pouchet replied. Parents or no parents, such was the question over which the famous duel began.

Pouchet declared that the cotton-wool fibre itself was organic matter, and might, therefore, have provided the particular elements needed for the peculiar conjunction of organic elements which results in the creation of new life. Pasteur heated the necks of his flasks, and when the glass was soft pulled out the necks and bent them downwards. Air, in order to reach the boiled fluid as the flasks cooled, had now to creep up the bent and drawn-out necks. The dust contained in it was deposited in the neck; none reached the flask. The fluid in the flasks remained sweet indefinitely.

But, Pouchet replied, how could the air be so thick with germs that wheresoever putrescible

stuff was exposed putrefaction always occurred? The clear air must be a veritable mist of microbes. It was a good answer and spurred Pasteur to the most strenuous activity. He skurried hither and thither, testing the air with his flasks in the following manner: He half-filled the flasks with putrescible fluid, drew out their necks to a point, and boiled the fluid in them. Whilst the fluid was in the act of boiling, with a flame and blowpipe he melted the glass of the drawn-out points of the necks and it glued together whilst soft. The flasks were hermetically sealed, in the technical phrase; no air could enter them. Pasteur then placed several sealed flasks in the air to be tested and waited till absolute stillness prevailed so that all dust produced by his own movement had time to settle. With a file he traced a line upon the drawn-out point of the neck below the seal. He then directed a flame momentarily upon the neck to burn away any dust that had settled upon it. He waited once more in order that any dust aroused might again settle. With steel nippers, also passed through the flame, he nipped through the point of the neck of the flasks, which he held with arms outstretched above his head. Air rushed into the flasks, sucked in by the partial vacuum that resulted from their having been sealed whilst boiling. With his flame Pasteur again sealed the flasks. Pasteur now had his flasks filled with the air he desired to test—air which held, of course, its own dust, but was not contaminated

by adventitious dust in so far as exceeding care could exclude it.

Pasteur opened twenty flasks on a country road near Arbois. Eight of them showed putrefactive changes. He took twenty to the top of Mont Poupet, near Salins, a mountain about 2,500 feet in height. Five flasks showed putrefaction. Pasteur wanted to go up in a balloon, but instead took himself to the Alps. He opened twenty flasks upon the Mer de Glace. Only one showed putrefaction. He opened twenty flasks in a crowded room. All showed putrefaction. The proof that germs were suspended in the air in proportions corresponding to the amount of dust in it was complete. The proof, however, was not generally accepted.

Pouchet, on his side, then undertook similar experiments, and his results differed entirely from those of Pasteur. Everywhere putrefaction resulted in his flasks. Pasteur did not endeavour to refute him. He felt sure these contrary results were due to faulty experimentation. Pouchet could not, or did not, take the same minute care as he himself had done. Dust from the experimenter's clothes, fingers, from the pincers had entered the flasks.

Pasteur had been elected a member of the Académie des Sciences in 1862. The dispute was consequently laid before the Academy in the following year. Further experiments were conducted by other experimenters with Pasteur's technique. Pasteur's results were confirmed.

The Académie accepted his demonstration that putrefaction was due to micro-organisms.

The controversy and the achievements of Pasteur made a great stir in the intellectual world of Paris. Society itself, always anxious to secure anything that presages power, felt called upon to attend the lectures that Pasteur gave upon his work. Three lectures were given in the spring of 1864. The lecture-hall was crowded with scientists and social celebrities, the eager and the *élite*. The stir created was like to that occurring in England at the same time due to Darwin's "Origin of Species."

It was not likely that Lister, in his keen search for any clue to the solution of the problems that haunted him, would not hear of the work of Pasteur. He did not, however, discover it until the early part of 1865. He was reading the *Comptes Rendus Hebdomadaires*, the weekly publication of the Académie des Sciences. The volumes for 1860, 1861, and 1863 contained accounts of the work upon fermentation and putrefaction. The most important of these papers appeared in the issue for June 29, 1863. It was entitled "Recherches sur la Putréfaction."

In this paper Pasteur began by saying that the interest and utility of researches into the subject of putrefaction had never been doubted. For a long time men had hoped to gain thereby a knowledge of diseases, and especially of those grouped together as putrid. Unhappily, the natural disgust towards such work, coupled with

its difficulties, had led to very few profitable results.

His own researches on fermentation, however, led him to endure the repulsive odours and the nausea, and even danger, associated with the subject in the hope of wringing from it secrets of profound and far-reaching value to mankind. "The public utility and the interest of humanity," he quoted from Lavoisier, "ennoble work that is in itself of a most loathsome character and causes enlightened men to see the zeal with which the disgust and difficulties must be overcome."

The subject of putrefaction, continued Pasteur, was so vast that he hoped to add greatly to the observations he had made. "The most wide-spreading result of my researches is simple enough. It is that putrefaction is determined by living ferments."

Pasteur went on to say that not only was the oxygen of the air not a necessary component of all putrefactions, but certain microbes causing putrefaction could actually live like fish without free oxygen, and died when exposed to it. These microbes caused putrefaction in the deep layers of putrescible fluid and took their oxygen again, like fish, from the fluid itself, turning it into carbonic acid gas. Other microbes preferred to live upon the surface, and took their oxygen directly from the air. Thus putrefaction could be superficial or it could be deep. It occurred where there was free air and where there was no free air, provided only the microbes had access

to the putrescible stuff. In all dead, putrescible matter one condition, and one condition only, was necessary to its putrefaction—namely the presence of microbes.

Lister, in reading, thought of the paralysis of the tissues, which he had seen come upon them as the shadow of death when they were irritated and injured. During such a temporary death, he thought, the tissues might well be subject to the microbes as if they were actually dead. Their protective vitality was wanting, there was nothing to prevent active microbes that had access to them causing them to putrify as if they were dead. He also thought upon the clotted blood in the wound. He had shown that the reason of blood-clotting was to be found in the loss of vitality of the adjacent tissues. The clotting, in fact, he had also seen to be a result of the tissues' temporary death, and the clotted blood itself he regarded as dead matter. Consequently tissues, when injured, being themselves and their fluids in a state of temporary death, had nothing to save them from putrefaction except an unbroken skin, which guarded them, or a vitality which, though diminished, was still able to resist germs that were neither too multitudinous nor too virulent. But if the skin was broken, if the germs were many and active, and if the vitality was depressed to a condition little different from death, then putrefaction was inevitable. Pasteur's work and his own seemed to link together as if with inevitable conjunction.

Lister, as far as is known, did not leave any account of the emotions which the perusal of Pasteur's papers aroused in him. They must have been very profound. One thinks he must have quietly left his house for one of those solitary walks which he was wont to take when a problem or far-reaching thought absorbed him, with the rapid beating of the heart and the feeling of breathlessness that accompany the adjustment of the mind to a sovereign idea.

CHAPTER V

THE DAWN OF SUCCESS

"In the fields of observation," said Pasteur, in his inaugural address as Dean of the Scientific Faculty at Lille, "chance only favours the mind that is prepared."

The work of Pasteur gave Lister the knowledge for which he had been seeking, and gave it to him and to him alone.

There were hundreds of other surgeons and doctors who would have exulted if by their efforts they could have seen the way to overcome the curse of blood-poisoning. A great number of them must have read Pasteur's writings, still more of them have known of his work. The "chance" was widely scattered, for Pasteur was not working in the dark, nor was he occupied with a subject that had no general interest. It was not obscure and technical, but one as universal in its attraction as the problems with which Darwin dealt. The problem of the origin of life is at least as attractive to the intellectual man and woman as the origin of species, and up till the time of Pasteur it had not been disproved that the creation of new life was not

going on in our midst and upon a very vast scale, and that the death of living matter did not shortly give rise to the birth of new life. Pasteur definitely showed that the evidences of the supposed creation of life were falsely read. He did not show how or when life originated—that remains a mystery. But he did show that the life arising in the processes of putrefaction and fermentation was not *de novo,* but from parents. In the question of parent or no parent, he convincingly proved the parent.

The whole question, therefore, was one which aroused intense interest. It affected, or appeared to affect, fundamental beliefs. Pasteur, a firm and devout Catholic, was attacked by representatives of the Church. Journalists hurled articles at all and every one, faithfully banging upon the big drum to draw attention to one of the latest shows in the fair of life. The discovery had ample advertisement, both for the serious-minded and the frivolous.

Yet the only mind amongst all the physicians and surgeons to receive enlightenment was Lister's. It is necessary to emphasize this point, for Lister's name is, of course, wrapped up with that of antisepsis. Others, as we shall see, had made use of antiseptics such as carbolic acid and chloride of lime. The ancient Egyptians had made use of antiseptics to preserve dead organic matter (the word in relation to the dead is scarcely suitable), and Sir John Pringle, President of the Royal Society in 1772, to whom

Pasteur paid tribute as "*le célèbre médecin anglais Pringle*," had done the same. But what singled Lister out from all his contemporaries was that he, with his peculiar intimacy with the nature of vitality, saw Pasteur's work in the light of a first principle ; he saw it through an understanding of human vitality, and in this, to my mind, he showed himself not only unique amongst his professional brethren, but a profounder philosopher than Pasteur himself. But I do not desire to urge this point. There was no shadow of rivalry between the two great men during their lifetime ; there should be none after their deaths.

Lister saw a vision of countless minute enemies awaiting the paralysis of the living tissues unprotected by the skin, just as vultures await the paralysis of a dying beast before they begin their fell work. Lister was almost certainly the only man in the world to whom that vision was peculiarly vivid. He saw the very refinements and details of the drama that would occur between the tissues and their enemies. Vitality, a word to others, was as familiar to him almost as the expressions and intonations of a child to its mother. It was intimate, personal, and peculiar to him ; it was his own. He had seen it with his own eyes, thought it with his own thoughts, described it with his own words. He had not accepted it from others ; it was his own, freshly and originally. His conception of it, therefore, had all the power of egotism, all that peculiar

virility and strength that is implied in the phrase "my own"; and "his own," belonging to the first principles of life, the gifts he fashioned from it, have had the widespread effects which gifts springing from first principles have.

Consequently, Lister, having read Pasteur's papers, was ready to begin practical work at once. His objects were, first, to destroy any microbes that, owing either to an accident or an operation, had reached the tissues of a patient; and secondly, to prevent any fresh ones getting to the wound. The tissues, unattacked, would have time to recover their vitality, and by growth and scar close the wound.

Lister therefore sought for some chemical which would kill the microbes which, if living, set up putrefaction in a wound. His choice fell upon the antiseptic which still holds the premier place—namely, carbolic acid.

An obvious and objectionable part of the process of decay is the odour produced. The Carlisle authorities made use of carbolic acid to abolish the odour of sewage, and it proved successful. Lister heard of its success and went to Carlisle to see the process for himself. Lister concluded that it prevented the odour by killing the causes of putrefaction—namely, the microbes. Other surgeons also knew of this power of carbolic acid to decrease fœtor, and they had used it in offensive wounds for that purpose. But they had not understood the mode of its action; they used it unintelligently, and conse-

quently with very varying and sometimes harmful results. Lister used it intelligently. He used it before the fœtor arose; he used it deliberately to kill the causes of the condition that gave rise to the fœtor.

The carbolic acid of that day was not the limpid, oily fluid that it is to-day. It was then a disagreeable-looking fluid, dark with tarry impurities and quite insoluble in water. Lister, therefore, was forced to use it in its full strength, and it seems strange now that it did not cause symptoms of poisoning to arise in the patient in addition to poisoning the microbes. But it did not do so. What it did was to excite the wounded surfaces to bleeding. The blood mingled with the carbolic and formed a hard crust. This was the first form Lister's famous antiseptic scab took.

Lister's first attempts in the new treatment were in patients suffering from injuries which had not only broken a bone but had also torn the skin—cases technically known as compound fractures. Through the torn skin air and dirt could pass to the damaged and paralysed tissues.

The choice of these cases was an obvious one. The impressive difference between the healing of fractures of bones in which the skin remained intact, and those in which the skin was torn had struck every surgeon. The first got well without much ado; the second always resulted in profuse suppuration, and not infrequently ended in death. Their terrible nature has already been

shown by quotations from John Bell. They were, without doubt, the most serious injuries from which men, and especially the inhabitants of such a city as Glasgow, could suffer.

Lister determined to concentrate at first upon these cases—their very fatality justified him. One can dare an experiment upon an otherwise hopeless, or almost hopeless, type of case which one ought not to dare in less dangerous forms of sickness.

Lister's first attempt was made upon a man who had sustained a compound fracture of the leg. It was made in March, 1865. A great deal, obviously, depended upon the result, and the result was death. The treatment received a check at its initiation. The case had been unfavourable from the beginning. The injury was severe and the man unhealthy. Lister deferred the repetition of his experiment until a patient arrived whose initial vitality and health was able to make a better fight than that of this worn-out product of a factory city.

A little boy, eleven years of age, had been run over by an empty cart. The wheel passed over his leg, broke both bones, and caused a wound through the skin that was an inch and a half long. There was not very much bruising or extravasation of blood into the muscles of the leg. The injury, in fact, though certain to result in suppuration, with the risk of greater dangers, at the commencement was not very severe. Lister directed his house-surgeon to take

a piece of lint of such size that it would cover and overlap the wound on all sides, to dip it into the crude carbolic acid, and to lay it upon the wound. The bones were then set and the leg put into splints. For three days all went well. Upon the fourth day the boy complained of pain in the wound. Suppuration generally began in wounds upon the fourth day. Doubtless the pain meant that suppuration had begun, and Lister was faced with a second failure. With anxiety he removed the splints and the lint and examined the wound. It was encrusted with a scab. There was no odour except that of the carbolic; there was no sign of suppuration. Another reason for the pain was revealed. The crude carbolic had burnt the skin, had caused the horny layers to peel off, and had left a raw and tender surface.

Greatly relieved and encouraged, Lister re-dressed the wound with a piece of lint which had been soaking in a vessel of water, at the bottom of which lay a thick, undissolved layer of the oily-looking carbolic acid. The sore was soothed, and gradually the pain passed away. When the wound was next examined the scab was still intact and the wound beneath it apparently healthy. The raw surface of the skin alone oozed with a little pus. Such was the cleanly picture which presented itself, instead of the loathsome discharge which soaked through layer after layer of lint and assailed the nostrils with its offensive odour.

Lister's comment upon this apparently unique

success was calm and restrained. There was no attempt to trumpet it forth or exaggerate its significance. Like Darwin, Lister was distinguished by a singular serenity, and also, like his famous contemporary, he was far more inclined to be the critic than the lauder of himself. "This, no doubt, was a favourable case," he wrote in his paper upon these cases in 1867, "and might have done well under ordinary treatment. But the remarkable absence of suppuration, and the immediate conversion of the compound fracture into a simple fracture" (by the hard scab protecting the purified wound, as does the unbroken skin) "with a superficial sore, were most encouraging facts."

Whether the easy recovery of this little boy was due to Lister's treatment or not, the next case upon which he experimented showed how needful it was for him to be present and to direct all the operations with his own sight and mind, which alone were intelligent in the matter.

A healthy man, thirty-two years of age, had been kicked upon the leg by a horse. The bones were broken, and the skin was also broken by a wound an inch in length, from which the blood welled. A piece of lint was dipped into carbolic and laid upon the wound. Carbolic dripped from this into the wound and mingled with the blood. A hard crust or antiseptic scab was formed. Carbolic acid is volatile. Consequently the scab, at first antiseptic owing to the presence of the carbolic, would lose this quality in a round

of hours owing to the evaporation of the carbolic. To prevent this Lister laid some oiled paper over the lint. The wound was now covered with an antiseptic cap that was airtight except at its edges. The leg was then splinted.

All went well until the seventh day. The patient's pulse was slow, his appetite was good, there were no signs of fever. The wound on being examined showed itself to be quite free from suppuration. But on the seventh day the injured man complained of pain in the wound. Lister examined it, and once again his examination, which might have revealed failure, assured him. The wound was healthy, but there was considerable irritation of the skin owing to the crude acid. Milder applications were used, as in the case of the boy, and soon the man was well except for a small superficial sore.

This small sore, one would think, was of no moment, but at the time Lister happened to be called away from Glasgow for a few weeks. The sore, safe under his charge, became as of old a portal of death. Gangrene seized upon it and gnawed its way rapidly into the living tissues. Only after amputation of the limb and a serious illness accompanied by great agony was the man, a mere cripple of his former self, discharged from the hospital. Lister was gravely disappointed to find the old enemy return when he was not present. But the event confirmed him in the conviction that the treatment must be conducted and proved by himself alone.

The next two cases that Lister treated were compound fractures of the arm. In neither case was there severe bruising or laceration, and the cases were such as might have recovered under the usual dressings, namely either a piece of dry lint or one dipped into ordinary water. Lister treated them with the lint soaked in carbolic, covered by a cap of sheet-lead to prevent the evaporation of the carbolic. They healed without suppuration.

In May, 1866, a case came under Lister's charge well calculated to test the value of the new treatment.

A man of the age of twenty-one was superintending the action of a crane in an iron-foundry. Whilst he was doing so a chain slipped and a heavy case fell obliquely upon his leg. A terrible injury resulted. Both the bones were broken and the skin was slit up. The torn blood-vessels had bled freely into the muscles and tissues of the leg. A further complication had occurred. Whilst the man was being carried to hospital, a considerable amount of air had been sucked into the wound owing to the movements of the leg, and this air had been churned up with the blood. The imprisoned air and blood together pressed upon the injured tissues. With their vitality already seriously diminished, the tissues were being squeezed to death by the pressure of blood and air.

In such a case the patient's chance is about as bad as it can be, so paralysed are the tissues

that they rapidly fall victims to their enemies the microbes. There was no case in which defeat of the man and triumph of the microbe was more certain unless some powerful mercenary were called in to protect the former's paralysed vitality. Lister saw the man within three and a half hours of the accident, so that such infection as had already occurred had not a long start of him. Lister resolved not to amputate, which was the treatment that any surgeon adopted in such cases. He determined to defend the vitality of the tissues until, thoroughly restored and carefully guarded from further attack, they set about the healing of the broken bones and the restoration of the torn and disorganized muscles.

Lister's first act in the defence of the tissues was to relieve them from compression. With great caution he squeezed as much blood and air from them as he could, distributing his pressure over a wide area, so as not to pinch the damaged tissues. His next objects were to kill any microbes that had got into the wound and to prevent the possibility of fresh ones entering. The usual lint soaked in carbolic was laid upon the wound and the lint was covered by a piece of tin-foil to prevent evaporation. The scab formed and the leg was splinted. Protected and at rest the tissues were left to regain the mysterious quality of vitality.

At first there was a little fever and fast pulse, but as the days passed the fever instead of mounting fell. Instead of the great swollen limb,

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Lister's first act in the defence of the tissues was to relieve them from compression. With great caution he squeezed as much blood and air from them as he could, distributing his pressure over a wide area, so as not to pinch the damaged tissues. His next objects were to kill any microbes that had got into the wound and to prevent the possibility of fresh ones entering. The usual lint soaked in carbolic was laid upon the wound and the lint was covered by a piece of tin-foil to prevent evaporation. The scab formed and the leg was splinted. Protected and at rest the tissues were left to regain the mysterious quality of vitality.

At first there was a little fever and fast pulse, but as the days passed the fever instead of mounting fell. Instead of the great swollen limb,

the throbbing pain, and the burning skin, the limb decreased in bulk, the skin was cool, the man had no pain.

The deep wound healed under the scab as quietly as a cut finger. The skin, excoriated by the carbolic, oozed a little. In six weeks the man was well except for the hardening of the scar.

This case Lister was unable to describe as "a favourable one, which might have done well under ordinary treatment." It was rather one "well calculated to test the value of carbolic acid," and its answer had been emphatically in the affirmative.

In these cases it will be seen Lister had caused healing to occur under a scab infiltrated with a substance which prevented its putrefaction.

A cynic might observe that all large wounds in animals heal under a scab, and the cynic would be quite right. He might even justly observe that animals were never exposed to the peculiar risks of these accidents as was man. Lister did in fact but permit a man in hospital to have the same chance as an animal in nature. But for man to get to the level of the animal in this matter was an enormous advance. The general chance for man was such that, had the animals been blessed with the peculiar gifts Mr. Kipling endows them with, and had they in consequence been cognizant of the insensate charity of man, they must have hung their heads in shame that such folly should be a quality of the lords of the world.

Encouraged by this striking success, Lister in the next severe case that came under his charge used carbolic with more daring. A boy of ten had his arm broken in three places and the muscles badly torn. One of the broken bones of the unfortunate child was protruding for about an inch through the skin. Lister had the boy put under chloroform, and then cut off the head of the protruding bone and the tags of torn muscle. He then soaked a piece of lint in the carbolic and sponged out the wound with it. Having cleansed the depths of the wound in this way, he dressed it in the usual manner. He then awaited the result.

The result was curious. Upon the fourth day, the day of suppuration, a pale grey discharge began to flow from the wound. Pale grey was always an ominous colour. It was the colour of hospital gangrene. But this grey was, it seemed, harmless. The boy's pulse did not become faster, but slower; his cheek was not flushed but cool. Clearly in spite of the discharge, the child was recovering from his terrible injury.

Lister, however, feared this discharge was the beginning of suppuration, so he applied the carbolic again freely to the scab, from under the edges of which the discharge came. His conjecture appeared to be right. The grey discharge not only increased in quantity, but it thickened and turned to pus. Such a result might easily have baffled an investigator.

Lister was attempting to avoid suppuration occurring in the wound by a remedy, with the result that the remedy was found to provoke it. Lister fortunately was not perturbed. He saw the boy as a whole and not merely as a broken arm. The boy was free of pain, his face was fattening, he looked confident, he had no lines of suffering nor the peculiar fear in the eyes which the observant surgeon knows how to recognize. Lister continued to apply carbolic, and it soon became abundantly clear that it was the carbolic that provoked the suppuration. Its irritation had made the skin sore and ooze in his previous cases. It now caused the tissues themselves to ooze in a like manner. But this discharge was very different to the acrid, offensive discharge that came from a wound infected with microbes. It caused no fever or other symptoms of blood-poisoning, and its cessation was readily brought about by the use of mild or less frequent carbolic. The boy made an uninterrupted recovery, and Lister learned that he could use carbolic freely in the depths and crevices of the wound and destroy any germs that had found their way to them.

The fifth severe case in which Lister used the carbolic treatment was notable for the determined grip which hospital gangrene took upon the case and its efforts to defeat the good results of the innovation. A "fine, intelligent boy," seven years of age, was knocked down by an omnibus loaded within and without, and the

wheels of this heavy vehicle passed over his right leg and smashed it unmercifully. So terrible was the shock and loss of blood that the contemplated amputation was not undertaken for fear it should extinguish the small spark of life that was left. Lister applied carbolic freely to the torn and crushed tissues. For a few days the child hovered between life and death and then Lister's triumph began. The huge wound commenced to heal, and the boy, for whom Lister evidently had no little love, got better in health. But there had been one small accessory sore caused by the accident. It was situated at a little distance from the major wound and not connected with the broken bones or torn muscles. This sore had not been treated with carbolic acid, and it was there that hospital gangrene laid its dread hold. The gangrene had eaten its way a little down into the flesh. Lister determined to find out how extensive it really was. He had the child put under chloroform and lifted the scab. Directly beneath the scab the tissues were healthy, but deeper down "a sight presented itself which filled me with horror." A battle ensued between antisepsis, caustics, and hospital gangrene. For months it continued, the gangrene, beaten back again and again, stubbornly retaining its hold and now and then making rapid and unexpected inroads. It was not until Lister was able to secure a separate airy room for the child that the gangrene was finally beaten. The boy recovered, and so well

had the poisonous effects of the gangrene been held in check that his health was soon excellent. The limb was partly crippled, but before he left the hospital he was able to limp about the ward. The victory was by no means complete, but the limb, in spite of the months of ding-dong battle, was of such use that the child could get about without a crutch. He had been ill for nine months. Only the utmost skill, care, and perseverance saved him.

The sixth severe case resulted also in a long fight between the forces of decomposition and the antiseptic power of carbolic. The patient was a man of fifty, broken down by work and ill-living. For four months the carbolic failed to get complete control over the putrefaction. The wall of a blood-vessel was attacked, an ulcer formed upon it and ate its way to the vessel. Blood gushed out, but the bleeding was quickly stopped; in a few days it gushed forth again. Worn out by loss of blood, the man eventually sank and died.

These six cases, in addition to four successful cases under the care of other surgeons who allowed Lister to direct the treatment, constituted his first antiseptic experience. They were spread over a period of eighteen months. There was also the initial case treated in March, 1865, and the two fractures of the arm with small wounds. In all there were thirteen cases. Of these thirteen two died. Two suffered from hospital gangrene, one recovering with and one without

amputation. The other nine patients recovered as if they had suffered from simple fractures and the unbroken skin had offered an impervious barrier to the microbes. Two of these, the cases of broken arm, had such slight skin wounds and general injury that Lister did not reckon them as important. It was in the remaining seven cases that he saw the dawn of success.

Patients with compound fractures of course frequently recovered without amputation. They even recovered in some cases without suppuration. When the injury and bruising was slight and the skin wound small, sometimes a natural scab would form, under which the deeper parts of the wound would heal without trouble. This occurred much more frequently in patients not brought to the hospital, but it also happened in hospitals, so that the famous John Hunter recommended that if a scab formed it should be let alone and the chance of deep suppuration occurring beneath it risked. Other cases of compound fracture recovered after weeks and months of severe and exhausting suppuration.

The figures of Lister's cases, therefore, were not large enough to be convincing. Thirteen cases with varying results were not a sufficient basis upon which to found a new treatment, unless there was something very peculiar about any of the cases. There was, in point of fact, this peculiarity. Seven of the cases were cases in which limbs had not only been broken and exposed, but had also been

passes down in front of the spine and commonly forms a white swelling in the groin. This form is known as psoas abscess, because the matter follows the course of a muscle called the psoas muscle. The ill-health of the patient, the tender spine, and the slowly increasing swelling in the groin were the signs of a disease, a shadow of death, from which, before Lister's day, there was no drawing back. The abscess, slowly increasing, would eventually burst and discharge its contents, or else be opened by the surgeon's knife. In either case, whether the patient were wealthy and at home or poor and in hospital, the same doom was inevitable. A condition known as hectic set in, under which the sufferer more or less quickly wasted and melted away. With other forms of chronic abscess it was a similar tale.

Mr. Erichsen, Lister's chief at University College Hospital, in 1864 wrote the following surgical description of hectic :—

" Hectic does not occur so long as an abscess, however large, continues unopened, but it supervenes with great rapidity when once its contents are discharged. I have known a large abscess to exist unopened for two years without any constitutional disturbance, but so soon as it was opened well-marked hectic set in, which speedily carried off the patient.

" Hectic is essentially a fever of debility, conjoined with irritation. Emaciation and general loss of power invariably accompany it. The

pulse, which is quick, small, and compressible, rises from ten to twenty beats above its normal standard; the tongue becomes red at the edges and tip; the cheeks are often flushed and the eyes glistening, with dilated pupils—all these symptoms have a tendency to exacerbations after meals and towards evening. There is also increased action either of the skin, bowels, or kidneys. Thus, profuse sweating, copious purging, and abundant red deposits in the urine take place; these discharges often alternate with one another, melting the patient away, and hence are termed colliquative. The debility gradually increasing, the patient rapidly wastes, and at last dies from sheer exhaustion, the conjoined result of fever, malnutrition, and wasting discharges."

Hectic is not a condition wholly abolished to-day. The success with which Lister treated it is not general to-day, for it requires a most minute and patient care. Other reasons apart from treatment also cause it to be a condition still seen by doctors. It is one of great sadness. It is more common in young people and children than in the old, and some of the saddest cases of disease which I have witnessed have been cases of chronic abscess, either psoas or connected with some joint, bone, or glands, which sapped away young and expectant life. In the days when Lister began his work upon them these unfortunates were all too common. The wards would always show one or more patients with

faces delicate in very truth with the fine silken skin, the red flush upon the cheek-bones, the glittering eye distinguished by the contrast of the brilliant blue-white sclerotics with the large black pupils, the red-glazed lips, and the temples with their pale blue veins. The fragile prettiness of children suffering from hectic, coupled with the virtues of exhaustion, the unresisting patience, and the passive obedience, moves the hearts of those who are touched by pathos, and provokes others to an intolerable anger that such a blight should fall upon the blossom of life.

Such cases of chronic abscess, it is now known, have for a cause the tubercle bacillus. Before these abscesses are opened, as Lister from the first pointed out, they are wholly free from the germs of putrefaction. But if they burst or are opened in a way not absolutely clean, or dressed uncleanly, then the germs enter and putrefaction begins at once, for the vitality of the tissues surrounding the abscess is weak and unable to offer any effective resistance.

Such, too, was the mental picture which Lister, in the light of the new knowledge, formed of the tissues about those abscesses. That which was a mystery to others was clear to him. It is true that the others did not believe it was a mystery to themselves. They thought the putrefaction occurred owing to the entrance of that fiery element of the atmosphere, oxygen, whose ardency set the burning hectic alight. They even devised valvular slits into the abscess, so

that it could discharge its contents without the air entering. But they made these slits with impure knives and hands not surgically clean, and did but start the final decline of their patient. Better put off the evil day as long as possible was Erichsen's advice and that of most leading surgeons. Let the patient go about with the abscess untreated, for where the surgeon stepped in to aid there the sexton followed all too speedily.

Lister, after his experience with compound fractures, now saw hope where formerly there had been no hope.

He did not make trial at once with these serious cases. He began with the common cases of acute abscess, carbuncles, boils, whitlows, and the like. After some initial failures, he gained success. These acute abscesses tend to get well. With Lister's treatment they all got well rapidly and cleanly, and the treatment he then adopted is still the most successful. Basing himself upon these successes, he then decided to make an attempt upon a patient suffering from one of the larger chronic abscesses, an attempt in which failure would surely result in death, but success would open up an unprecedented path of hope to these unfortunates.

A middle-aged man with a psoas abscess occupied one of the beds in his wards. The abscess was a large one, extending from the spine to the groin, and holding over a pint of matter. Lister decided to open it. He had by

this time found that the undiluted carbolic acid was too caustic to be kept for any time in contact with the skin. He therefore dissolved the carbolic in four parts of boiled linseed-oil. He took a rag, soaked it in the carbolic oil, and then laid it over the swelling in the groin, leaving the carbolic to cleanse the skin. He also soaked his lancet in the oil.

He then carefully raised the edge of the rag, slipped his lancet underneath it, and thus, under cover of a carbolic veil, opened the abscess. The matter welled up and ran from under the rag. When it had ceased to do so a fresh rag, soaked in the carbolic oil, was spread upon the wound and the surrounding skin. Lister then mixed some of the carbolic oil with carbonate of lime to make a putty, which he named "the antiseptic putty." He spread this putty upon thin sheets of metal and moulded this dressing to the wound and surrounding skin, with the putty next to the wound. In this ingenious way Lister set between the wound and the outer world an antiseptic cap, which preserved both its consistency and its antiseptic powers. The carbolic could not evaporate through the metal, and the putty was too firm to be washed away by the discharge, which passed through it and oozed from under the edges of the metal sheeting. At this edge the germs could get to it and cause the usual decomposition. But it was then some distance from the wound and the weakened tissues that surrounded the abscess. Lister thus

removed the situation of the decomposition from the wound and abscess to a safe distance outside and away from them.

Lister's attention and care in this case was extraordinary. From day to day the most trifling detail or slight alteration of the conditions was carefully considered and met. In general, day after day passed with tedious monotony, without any signs of retrogression and without any relaxation of his rightly meticulous zeal. Finally, after six months the reward came. "I had the inexpressible happiness of finding the sinus closed," he wrote. "For months past we had persevered with the antiseptic dressing, although the discharge did not amount to more than a drop or two of serum in the twenty-four hours, well knowing by bitter experience that so long as a sinus existed the occurrence of decomposition might produce the most disastrous consequences, and at length our patience has been crowned with success."

The reader will see what peculiar gifts of perseverance and profound faith in the new germ theory of decomposition were necessary to effect this success. The change in the way of regarding a case was a radical one. Under the knowledge and feeling of the inevitability of decomposition in these and kindred cases, surgeons were wholly unaccustomed to minute care. There was no association and tradition of minute care connected with such hopeless conditions. The radical change and complete

break from the accustomed attitude Lister alone was able to make. His professional brethren attempted his treatment, but without his indomitable patience and faith. Either they relaxed their attention when success seemed assured or else abandoned it upon the first drop of pus and adopted the fatal poultice, or their curiosity tempted them to expose the wound too freely to see how matters stood, and even to probe the wound and measure its depth and size. Before Lister had been at work three years we find him asserting that " without a firm faith in the truth of the germ theory, perplexity and blunders must be of frequent occurrence " ; that the abandonment of his treatment for water-dressings or poultices when a little pus appeared " would in many cases sacrifice a limb or a life " ; and warning other surgeons not to " pry into the source of suppuration so long as all is going well otherwise ; for such a course, by admitting germs into the interior, may produce the most disastrous consequences in an otherwise promising case." Already he was beginning to be hampered by practical men, who wanted to get to work without due consideration and humble studentship—incidental men, one might call them, in that they live in the day's work, want quick returns, and like to be " in the know " of what is going on in the world of men, rather than humbly wait upon the guidance of Nature. The firm faith which restrained Lister from satisfying what, in his case, amounted to

the almost legitimate curiosity and inquiry of the pioneer, because he considered that if the germ theory were true his patient would suffer from his prying, is not one of the least of those magnificent qualities of character which led him to success.

Lister repeated his treatment of chronic abscess in such patients as were fortunate enough to be put in his charge. "I have opened numerous abscesses connected with caries of the vertebræ, the hip, knee, ankle, and elbow, and in all cases I have found the discharge become in a few days trifling in amount, and in many it has ceased to be puriform in twenty-four hours." How different to the "colliquative discharges," under which the patient melted away, in the graphic language of Mr. Erichsen!

Darwin worked for twenty-one years at the completion and proof of his theory before he gave it to the world. But the antiseptic theory of his compeer was too fraught with practical good to mankind for Lister to keep it to himself until completed to his liking. Hence, though he resembled Darwin perhaps more closely than any man in the century in his complete absorption in his work and indifference to any fame it might bring him, before he had fully proved this treatment of chronic abscess he published it in the *Lancet*. Its results had been satisfactory and consequently "it does not seem right to withhold it longer from the profession generally." "In suppuration of the vertebræ or of the

joints," he continued, " the results of this system are such as I ventured with trembling hope to anticipate ; patient perseverance being rewarded by a spontaneous cure in cases where excision, amputation, or death must have resulted from any other known system of treatment. In short, the element of incurability has been eliminated from caries."

Quiet and restrained as always, his report was absolutely free from all tinge of advertisement or self-laudation. There could scarcely be a more simple announcement of a great victory over a disease, hitherto regarded as hopeless, than the words, " in short, the element of incurability has been eliminated." " The trembling hope " of one whose heart had been sorely tried by the picture of incurable suffering had been rewarded. Compound fractures and chronic abscesses having fallen before him and such lesser troubles as cuts and ulcers having yielded to him, Lister now turned to the great problem of making operations safe. He recognized that pure carbolic was unsuitable in operative technique. The cut made by a surgeon's knife was clean and did not lacerate the tissues. The injury to their vitality was not great. At the same time, blood and serum collected in the area of operation and were wont to putrefy readily. The problem, therefore, was not so simple as the placing of an antiseptic veil and cap over a wound. That was sufficient after the operation, but what was to be done to shield the tissues and

juices during the operation? Lister tried various plans. "I have devoted a good deal of attention to this class," he said to the members of the British Medical Association meeting in Dublin in August, 1867, "but I have not as yet pleased myself altogether with any of the methods I have employed." He had obtained from Mr. Calvert, of Manchester, a purer form of carbolic acid, which dissolved in twenty parts of water. By the use of this watery dilution he had been able to diminish the caustic effect of the carbolic and had kept operative wounds clean and healthy. But the subject of the management of operations was a vast one and far more complicated than the treatment of compound fractures and abscesses. Lister, therefore, held his peace until he could be more definite.

The danger of operations undertaken in public hospitals was exceedingly great. Indeed, there was little that showed so markedly what death-traps these institutions of charity were. Lister was not the only surgeon who was appalled at the gulf which separated profession and practice. Sir James Simpson, the famous discoverer of the anæsthetic powers of chloroform, was equally impressed that the surgical hospital bore an ominous resemblance to a slaughter-house. Lister, convinced of this character of the hospital, had pondered over the matter and found its solution. Simpson, the victor of a famous controversy as to the justification of anæsthesia, armed himself to convince both the profession

and public of a truth which familiarity and indifference had obscured.

The operations which were most commonly undertaken were amputations. They were sometimes imperative, and only the imperative operation was dared in the hospital if the building harboured the usual fell blood-poisonings. Simpson wrote round to the practitioners in Great Britain and collected statistics of amputations undertaken in country practice where a hospital was not available. He published his results in 1869, two years after Lister had first announced the virtues of antisepsis.

In all he collected reports of 2,098 amputations, of which 226, or 1 in every 9, died. The most serious amputations were those undertaken through the thigh on account of injury. Of these 1 in every 4 died.

He then collected from the Edinburgh and Glasgow Infirmaries and the London Hospitals reports of 2,089 amputations. Of these 855 ended in death, or 2 in every 5. Of amputations made through the thigh on account of injury, 2 in every 3 resulted in death. Nor was the toll of death the only measure of disaster. There were no statistics which could tell of the unspeakable agony patients suffered as the gangrene gnawed at the living flesh, of the sharp cries of pain and the tragic prayers breathed to the Divine mercy for the speedy gift of death.

Even the operations undertaken outside the precincts of a hospital showed too many victims

due to poisonous germs implanted in the wound by the fingers, instruments, and dressings of the administrating surgeon. Over a quarter of the deaths outside the hospital were due to these germs, and in the light of modern knowledge probably many more. But the notable fact which had been strangely overlooked and for which Simpson demanded general attention, was that hospitals, and especially the large ones, were places where these diseases were bred to a fearful state of virulence, a fact demonstrated in the modern laboratory, where it has been shown that as microbes pass successively from victim to victim they increase in virulence.

"The tremendous differences between the two practices," wrote Sir James in concluding his essay, "may perhaps be more pointedly and simply stated thus:—

Out of 2,089 amputations in hospital practice 855 died
Out of 2,098 amputations in country practice 226 died

Giving an excess in hospital practice of 629 deaths

"This excess in about 2,100 amputations of 629 deaths in hospital practice as compared with rural practice—in our palatial hospitals as compared with our rural villages and cottages, in large wards as compared with isolated rooms—is certainly much greater and more pronounced than I myself expected when I began the present inquiry. But must the calling of this dismal

death-roll go on unchallenged and unchecked? Shall this pitiless and deliberate sacrifice of human life to conditions which are more or less preventable be continued or arrested? Do not these terrible figures plead eloquently and clamantly for a revision and reform of our existing hospital system?"

Howsoever carefully statistical evidence has to be sifted, yet the large set of figures and striking differences which Simpson obtained laid bare the deadly nature of hospitals in an undeniable manner. Nevertheless there arose an abundance of deniers and repudiators. No profession will allow its good intentions to be demonstrated as being pernicious in practice. No body of men cares to have it shown that their good will is more notable than their good sense. No doubt the surgeons of that day did their best, but "doing their best" may have condoned but did not destroy the ill-effects of incompetent workers. Until Lister came, hospital surgeons, despite their operative skill, were gravely incompetent; and the one great lesson taught by Lister's salvation of the hospitals is that it is imperatively necessary for genius to guide mankind through the treacherous paths of ill-instructed charity.

There were, however, some who joined with Simpson in protesting against the hospital. "Must hospital surgeons ever remain content with losing one-third to one-half of *all* their amputation cases, and nine-tenths of some?"

asked Erichsen, aghast at the results of his inquiry into "hospitalism"; and Mr. Cadge, of Norwich, declared that "although a hospital may not be the mother of pyæmia, it is its nurse." Such supporters were, nevertheless, few.

The orthodox, on the other hand, were outraged by Simpson's heresy. The hospitals were the very temples of their faith and rites. Mr. Holmes voiced the outcry at Simpson's "heavy charge" against the hospitals—"no less than that of deliberately sacrificing the lives they were instituted to preserve." So indignant were the orthodox that it is more than doubtful if the accusers of hospitals could ever have destroyed this system of the collective treatment of the sick. One thing that made such an abolition peculiarly difficult was the increase of industrialism, which not only crowded men together, but also greatly increased the number of accidents. Large hospitals in the centre of these growing industrial towns seemed indispensable. At any rate, they were erected in numbers and subscribed to by the wealthy and benevolent. Others were enlarged. Provision against accident was in this way made, and the result was that the dangers of accident were enormously increased. The horrors of the early days of industrialism have often been depicted, but the hospital side of the gloomy picture is little known. It was terrible. It made the need of a Lister especially urgent. Hospitals previous to industrialism were not such fearful death-traps

as they then became. The statistics of the pre-industrial days were not carefully kept, but such as they were they showed that the old hospitals were three or four times as healthy as the palatial buildings erected in the new industrial centres.

What was to be done? Sir James Simpson, amidst a loud chorus of protest, boldly declared that the large hospitals must be utterly destroyed and replaced by a large number of huts, each hut lodging one or at the most two patients, and further that these "villages" should be built of iron instead of brick and stone, so that they could be taken down and rebuilt every few years. Erichsen, less bold and radical, gave a list of seventeen rules to be followed in hospitals by which "much may be done to lessen the mortality from septic surgical diseases in hospitals." Most surgeons, however, possessed and desired only blind eyes when turned upon the spectre of disease, and some of the leaders flatly declared that they did not believe Simpson's figures were true, and if they were true that they did not believe the deductions made from them. Even Erichsen joined the latter party and Simpson seemed to stand alone.

But there could not have been a mightier champion of a cause than Sir James. The name of the discoverer of chloroform loomed large in the eyes of the public, and when he came forth with his great accusation the public at least turned an attentive ear. With the shrewd instinct it has for those things that concern its welfare

and with an equally shrewd instinct as to the prejudices of a profession, whether scientific or theological, the public forced an inquiry.

In consequence the matter was taken up at the thirty-seventh meeting of the British Medical Association, held in 1869 at Leeds. The meeting showed vividly what a bomb Simpson had cast into the midst of the profession by the publication of his figures. Many of the surgeons attendant upon the hospitals from which Simpson had drawn his figures felt that a personal affront had been done to them. The diseases which they regarded as the inevitable sequences of nature were now by the audacious Simpson declared to be disasters for which they and their hospitals were personally responsible. Other surgeons, such as Mr. Jonathan Hutchinson, by making general remarks as to the difference between town and country, thought to throw discredit upon the figures. Others brought out little lists of successes, which they thought, David-like, might slay the giant Simpson had erected. Professor Bennett, a colleague of Simpson's at Edinburgh, and another of the famous fighters of that University, caustically remarked amid loud remonstrances that he was one of the extremely rare medical philosophers who definitely cared for the truth, and proceeded to say that Simpson's statistics were fallacious and the dawning belief in the existence of germs pitiable. Altogether the debate was of such a character as to be found by the *Lancet* to be " satisfactory

and reassuring" and to show that "there is no ground whatsoever in any facts which have been satisfactorily proved for the general outcry which it has been attempted to raise against hospitals of moderately large size to supply the wants of large populations."

So in spite of the fœtid atmosphere of the wards in which surgeons worked, in spite of the vigorous eloquence of Sir James Simpson's speeches at this meeting—speeches which, if read to-day, still ring with a splendour of insight and conviction and a high superiority above those of other speakers—in spite of the fact that the faith of some surgeons in their hospitals was shaken by Simpson's bomb, it seems certain that the view of the *Lancet* that all was well with the hospitals would have prevailed, and at the most only little by little would improvements have been effected.

A few tentative and sceptical remarks were made upon Lister's work at this meeting. Only one surgeon—Mr. Macleod—spoke emphatically in its favour, and he was one of Lister's colleagues at Glasgow Infirmary. Sir James Simpson himself gave a few words to this aspect of the question: "I am rather hopeless of the evils of hospitalism being cured by any such agent as carbolic acid."

Meanwhile, Lister kept outside all this controversy. Convinced that he had the clue to hospitalism, he could afford to ignore figures and set himself to building up the hospitals anew.

It was the best thing to do. Had the movement which Simpson attempted to arouse succeeded, as in those days it ought, upon its merits, to have succeeded, all the big hospitals might have been pulled down with as great a zeal as once despoiled the Catholic churches. Indeed, in Prussia the process had already begun. Large hospitals were being abandoned and hut hospitals substituted. Lister's work, then, came in the nick of time. It saved not only patients but hospitals. It prevented a very heavy expenditure of public money and an entire reversion of the method of dealing surgically with the poor. In the light of events, then, one can be grateful to the obtuse conservatism of Sir James Simpson's critics and opponents.

Lister, having proved himself victorious over compound fractures, abscesses, and accidental wounds, now set himself to prove that death could be beaten back from patients who had to submit to the knife.

Lister, as has been said, declared himself, at Dublin in 1867, discontented with his methods of dealing with the problem of operations: "I have not as yet pleased myself altogether with any of the methods I have employed. I am, however, prepared to go so far as to say that a solution of carbolic acid in twenty parts of water, while a mild and cleanly application, may be relied on for destroying any germs that may fall upon the wound during an operation." A few months later, relying on solutions of

carbolic, he did a thing no other surgeon would have dared to do. To straighten a foot that had been rendered useless by an accident, he opened the ankle-joint. "This," he said, "I should not have dreamed of doing without the aid of the antiseptic system, being well aware of the disastrous course such injuries commonly run under ordinary management." He and his dressers first made everything scrupulously clean, and hands, instruments, sponges, etc., were purified with carbolic solution. The wound, throughout the operation, was wetted with watery carbolic and finally dressed with carbolic oil. The operation was, in fact, carried out with an antiseptic technique which was thorough if not refined. The result was a complete success, and in a short space of time the patient was able to walk "firmly and well."

But though such cases were encouraging, there was one great hindrance to operations, and especially such operations as amputations, doing well. This was the question of stopping the blood flow from the severed arteries.

The profession had, of course, long given up the barbarous method of plunging the stump of an amputated limb into boiling oil. The great French surgeon Ambroise Paré (1510-90) introduced the ligature of arteries, and his method of stopping bleeding had been generally adopted. A piece of silk or whipcord was passed round the cut end of the artery and tightly tied. But the ligature, though better as a method of

stopping the bleeding than boiling oil, had a grave disadvantage—it did not melt away in the tissues and it was not germ-free. Consequently, it always led to suppuration, and this suppuration always continued until it was removed. The method of removal was to leave the long ends of it hanging out from the wound and to wait until the knot had rotted through the artery. The ligature was then pulled away, and the artery was left closed by the blood-clot that had formed within it. As a consequence of the ligatures, no wound in which an artery was tied could possibly heal without suppuration, and suppuration once established frequently did not cease with the removal of the ligature, but continued to waste the patient's strength. There was, moreover, a further danger. Sometimes the blood-clot which formed in the tied artery also became seriously involved in the suppuration; it began to soften, and became loose. A terrible rush of blood would result—the so-called secondary hæmorrhage—a sudden rush which frequently killed the patient before any attendant could get to him. Ligatures, therefore, not only caused inevitable suppuration, but they also involved the danger of this dreadful, sudden flow of blood. But both events were regarded by the mass of the profession with the indifference that is shown to the inevitable in others. Some surgeons, seeing nothing but good in their own works, went even farther, and actually congratulated themselves upon the excellent

paths for discharge these filthy bits of silk provided.

The stronger men of the profession, able in the consciousness of their power to submit themselves and their work to a more drastic criticism, recognized the evil of these foreign bodies in the healing flesh. The great John Hunter and Sir William Lawrence both declared suppuration to be inevitable as long as ligatures were inevitable. The latter recommended, as a measure of relief, that ligatures should be cut short, only the part that surrounded the artery being left, and the wound closed. But this led so frequently to deep abscesses, necessitating the re-opening of the wound, that Lawrence abandoned it. Other surgeons tried animal ligatures made out of sheep's gut (the so-called catgut) or of the sinews of deer, in the hope that these ligatures would get absorbed in the wound without trouble. Others, Dr. Levert, of Alabama, being the innovator, used fine metal wire for ligatures. These wire ligatures were the most successful, for metal cannot soak up juices and harbour germs as does silk or thread. Nevertheless, they often caused suppuration, and more frequently neuralgic pains, and had to be cut out. The subject of ligatures, in fact, seemed insoluble before Lister took the matter in hand. The profession regarded the silk or thread ligatures with the long ends lying outside the wound as orthodox, and, as has been said, not infrequently converted their vice in causing suppuration into

the virtue of providing paths of exit for the discharge they themselves caused. The question, indeed, was regarded in the same light as that of the hospitals.

The resemblance was very close, for in this matter, too, in the sixties, the profession was divided into three groups. One division, the largest, consisted of the profession as a whole, following contentedly or perforcedly the orthodox method. The other two divisions, the important ones, consisted of two men, Joseph Lister and Sir James Simpson. The latter gentleman, with characteristic force and eloquence, was telling surgeons that by strangulating the arteries with ligatures they were sowing their wounds " with morsels of dead flesh." He had been impressed by the comparative success of wire ligatures and by the " tolerance of metallic bodies by the living tissues of the body." As a consequence, after prolonged and careful research extending over some years, he devised an ingenious method of temporarily compressing cut arteries until the blood in them firmly clotted, between long needles thrust in various ways into the wound. The needles were in a few days withdrawn. This system he called acupressure. The old system of ligatures, like the old system of hospitals, he wanted utterly abolished. Indeed, he prophesied that within two or three generations ligatures would be abolished and acupressure would be the orthodox and successful method of stopping hæmorrhage, and he ended his plea for acu-

pressure with a caustic comment upon his professional brethren: "It is mere idleness and frivolity to argue, as has been lately and earnestly done, that no efforts should be made in this direction, because surgeons are generally quite content with the ligature, in despite of its evils, and have no wish to change." Such was the vigour of his accusation, which aroused strong resentment amongst the surgeons, so that James Syme, in the presence of his students, denounced Simpson's "vulgar insolence" and tore up and flung away the pamphlet sent to him by its distinguished author.

Lister again took no part in the controversy, but gave a great deal of thought and study to the question of ligatures. He saw at once that it was the decomposition of the fluids lying stagnant in its interstices that rendered the silk so noxious. But it was not until the antiseptic method, by its success, gave him time for concentrated thought and experiment that Lister began to see light, and began to establish the two methods of ligaturing that have now become the orthodox practice of the profession.

The first clue to the ultimate triumph was one the significance of which probably would have escaped any other medically trained eye except Lister's in all Great Britain; and in the measure of men it is this astonishing immediacy of understanding of the first principles of Nature which lifts Lister to the rank of genius. Simpson was the greatest practical medical man of the

time, taking facts as they stood and acting upon them. He saw that in the hospitals disease bred to virulence; therefore, he said, destroy the hospitals. He saw that the wire ligature did not irritate like silk, and devised acupressure. But Lister was something more than a practical man. He read the mysteries of Nature anew. He was the interpreter of Nature to man, the προφήτης of the Greeks, and based himself upon an actual observation of what Nature herself did.

The clue occurred in the third case of compound fracture treated by the antiseptic method. Lister was lifting up a piece of the crust formed by the blood and carbolic when he noticed a little cavity in it filled with brownish fluid. To the ordinary eye this would have meant nothing. Such cavities not uncommonly form in crusts and scabs. But on touching the wall of the little cavity Lister noticed that it bled; in other words, it was alive, for only that which is alive can bleed. What, then, had happened? A cavity had formed in a crust of blood and carbolic acid —that is to say, in matter which was dead. Yet by some strange magic this same matter in which the cavity had formed had now become alive. Lister saw at once that the living tissues had eaten into and replaced the dead matter around the cavity. Lister stored up in his mind this discovery of this hitherto unknown power of the tissues.

His fifth case, of the "fine, intelligent boy, seven years of age," gave him a more extended

view of this power of Nature. A piece of dead bone was always believed by surgeons to crumble and exfoliate, and discharge itself in fragments through a wound in the skin. In the case of this boy, Lister observed a piece of dead bone in a wound kept pure and at rest with carbolic acid. On removing the dressing one day, Lister was surprised to find the bare white bone covered with a thin, pink flesh. Moreover, when he touched the bone with a probe, he found it as frail and honeycombed as the paper of a wasp's nest. The living tissues had already eaten most of the dead bone up, and were eating the rest up too. Lister again carefully noted this new natural power. On brooding over it, he saw that the question of ligatures could be solved.

If the living tissues could eat up dead bone and dead blood-crust, why should they not also eat up some form of ligature, if the ligature was kept free of microbes, and so the living tissues about it were able to perform their natural functions? If the ligature was eaten up, then there would no longer be any need for long threads to be left hanging out of the wound. The ends of the ligature could be cut short and the wound closed and the ligature left to be absorbed by the tissues. Such wounds, then, as those of amputation might be made to close as rapidly as a cut finger. Lister quietly wondered whether "this particular branch of the subject will yield all that it promises."

No innovation such as Lister projected is first

tested by a surgeon upon man. A horse in a veterinary establishment needed operation. Lister was informed, and used the opportunity to tie the artery in the horse's neck with a silk ligature which had been soaked for two hours in a solution of carbolic. The ends of the ligature were cut short and the wound entirely closed over them. What would happen beneath? Would the tissues eat up the silk? Lister waited for ten days, and then removed the antiseptic dressing. All was well; the experiment had apparently succeeded. In five weeks, however, the horse died. Lister was able to examine the ligature he had tied; it was quite healthy. The silk itself was bridged over by new tissue, but it was not absorbed or eaten up. The time, it is true, had been brief; nevertheless, the silk was quite unchanged, as unchanged as a wire ligature. Still, the result was satisfactory. It was better to have soft silk buried in the neck than hard wire. An advance had been made, but the perfect result of the absorbable ligature had not been obtained.

Lister was emboldened by this success to attempt a buried silk ligature in a human being. The case he chose was not a favourable one. A lady suffered from a gluteal aneurysm—that is to say, from a saccular enlargement of the large artery of the buttock. Such an enlargement is scarcely an indication of a healthy artery. Nevertheless, Lister made his first human trial upon this diseased artery.

The whole operation was carried out with careful antisepsis. The silk ligature was first soaked for two hours in a concentrated solution of carbolic, and was then transferred to a weaker solution. This was done to dilute the carbolic and weaken its caustic effect upon the tissues, for, as Lister said, "the less the antiseptic comes in contact with the living tissues the better, so that unnecessary disturbance from its irritating properties may be avoided." Lister used the same dilute acid for his instruments, the sponges, and washing out the wound.

The patient did well. Previous to the operation she had been "in agony." After the operation she lived for about ten months "in fair health and strength." She then died suddenly. The disease of her arteries had been general. Another aneurysm, one in the chest, had burst, and she bled to death into her own body. Lister made a post-mortem examination. He found the silk ligature around the artery only a little altered. The knot was a little eroded, the cut ends a little shorter, the loop a little thinner. The absorption was so slight that Lister was mostly surprised at the silk's resistance to being eaten up. Lister carefully examined everything with the microscope. He tracked the fate of the minutest thread.

Lister had not achieved his object with the silk. He turned to the so-called animal ligatures, which had once been tried by the profession and had been abandoned. Catgut, a thread made

from sheep's gut, was the one he chose. This he soaked in carbolic oil. With the same antiseptic precautions he tied the large artery of the neck of a calf. At first the catgut snapped, but eventually, with a less brittle thread, Lister succeeded. All went well, and a month later the calf was killed. He examined the artery. To his great disappointment the ligature apparently had not altered. He examined it more closely, and his keen eye observed that " the dirty grey of the softened catgut had turned to a dirty pink." The pink was the flush of early life. Under his microscope he saw this clearly. The ligature had been penetrated and replaced by living tissue. The form had remained the same, but Lister's Galatea had become suffused with life. He quietly announced his victory over the baffling problem of the ligature. " In this form " (carbolized, and with antiseptic treatment of the wound) " the gut seems almost a perfect material for the ligature under any circumstances in which it is required."

But Lister was not yet finished. It was a characteristic of his never to rest until he had completed a task which he had taken up. Lesser matters of the day always had to be completed, though the midday meal were deferred until late afternoon and the evening meal to the hours about midnight. Larger tasks were pursued with a like pertinacity before Lister would rest. His gifts were never partial; they were complete and perfect; they needed no additions from the

hands of other masters. Lister therefore determined to eliminate the word "almost." Catgut should no longer be "almost perfect" as a ligature; it should be as perfect as Nature herself, in the making of sheep's gut, would allow.

Its defect was the defect from which he himself had suffered when operating upon the calf. Soaking it in carbolic caused it to soften and to snap when the knot was being tied. Further softening occurred, due to the imbibition of the juices of the tissue, so that there was a risk of the ligature failing to hold the artery efficiently. Lister was not able to overcome these defects whilst he was Professor of Surgery at Glasgow. The work occupied him for another twelve years. During that time he visited factories where catgut was prepared and mastered the whole process of its preparation, from its origin to its completion. Basing himself upon the knowledge he gained of the original scraping, twist, drying, seasoning, etc., of the catgut, he carried out "hundreds of experiments," each one of which "added something to my knowledge of it." His knowledge of chemistry, preserved since the days when he was a favourite pupil of Graham at University College, stood him in good stead. He himself carefully tested all the chemicals he needed, and described their advantages and defects. He also investigated the mechanical qualities of catgut and the effects of tension and strain; he tested the effect of age upon it. There was, indeed, no possible thing, either trifling

practical detail or profound mystery of Nature, bearing upon the matter, from the time the gut left the sheep to the time it was eaten up and replaced by the living tissue of the body, that he did not personally master. The final result of his labours was the chromic gut which the surgeon and student handle to-day, not cognizant, as a rule, of the evidence it is to the original creative quality of genius, which bases itself directly upon Nature and direct observation, and never upon the teachings of mankind.

CHAPTER VII

THE MIRACLE

Sir James Simpson, in his attack upon hospitalism, gave, among other statistics, those of the amputations carried out at Glasgow Infirmary between 1847 and 1868. They had the distinction of being equal to the worst. Glasgow Infirmary, in fact, had an evil reputation, and so peculiarly evil a situation, that it seemed as if it had been specially designed in order most rigorously to test Lister's attack upon disease. No more unfavourable conditions could well be imagined. Yet Lister's triumph was complete. The conditions under which it was won cannot be better given than in his own words. The quotation is a long one from a paper published in 1870, but its sedate account of the turning-point of all surgery should make the words classical :—

" The antiseptic system has now been in operation sufficiently long to enable us to form a fair estimate of its influence upon the salubrity of a hospital. Its effects upon the wards lately under my care in the Glasgow Infirmary were in the highest degree beneficial, converting them

from some of the most unhealthy in the kingdom into models of healthiness. The interests of the public demand that this striking change should be generally known." Lister continued with a particular description of the infirmary and the new wing erected in 1860: "To the great disappointment of all concerned, this noble structure proved extremely unhealthy. Pyæmia, erysipelas, and hospital gangrene soon showed themselves, affecting, on the average, most severely those parts of the building nearest to the ground, including my male accident ward, which was one of those on the ground floor, while my female ward was immediately above. For several years I had the opportunity of making an observation of considerable, though melancholy, interest—viz., that in my accident ward, where all or nearly all the beds contained patients with open sores, the diseases which result from hospital atmosphere were sure to be present in an aggravated form; whereas, when a large proportion of the cases had no external wound, the evils in question were greatly mitigated or entirely absent. This appeared striking evidence that the emanations from foul discharges, as distinguished from the mere congregation of several human beings in the same apartment, constitute the great source of mischief in a surgical hospital. Hence I came to regard simple fractures, though almost destitute of professional interest to myself and of little value for clinical instruction, as the greatest blessings; because, having no external

wound, they diminished the proportion of contaminating cases. At this period I was engaged in a perpetual contest with the managing body, who, anxious to provide hospital accommodation for the increasing population of Glasgow, for which the infirmary was by no means adequate, were disposed to introduce additional beds beyond those contemplated in the original construction. It is, I believe, fairly attributable to the firmness of my resistance in this matter that, though my patients suffered from the evils alluded to in a way that was sickening and often heartrending, so as to make me sometimes feel it a questionable privilege to be connected with the institution, yet none of my wards ever assumed the frightful condition which sometimes showed itself in other parts of the building, making it necessary to shut them up entirely for a time. A crisis of this kind occurred rather more than two years ago in the other male accident ward on the ground floor, separated from mine merely by a passage twelve feet broad; where the mortality became so excessive as to lead, not only to closing the ward but to an investigation into the cause of the evil, which was presumed to be some foul drain. An excavation made with this view disclosed a state of things which seemed to explain sufficiently the unhealthiness that had so long remained a mystery. A few inches below the surface of the ground, on a level with the floors of the two lowest male accident wards, with only the

GLASGOW INFIRMARY.

The wards where Lister worked his miracle were in the hinder building.

(*Block lent by the Infirmary.*)

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basement area, four feet wide, intervening, was found the uppermost tier of a multitude of coffins, which had been placed there at the time of the cholera epidemic of 1849, the corpses having undergone so little change in the interval that the clothes they had on at the time of their hurried burial were plainly distinguishable. The wonder now was, not that these wards upon the ground floor had been unhealthy but that they had not been absolutely pestilential. Yet at the very time when this shocking disclosure was being made I was able to state, in an address which I delivered to the meeting of the British Medical Association in Dublin, that during the previous nine months, in which the antiseptic system had been fairly in operation in my wards, not a single case of pyæmia, erysipelas, or hospital gangrene had occurred in them; and this, be it remembered, not only in conditions likely to be pernicious but at a time when the unhealthiness of other parts of the same building was attracting the serious and anxious attention of the managers. Supposing it justifiable to institute an experiment on such a subject, it would be hardly possible to devise one more conclusive."

Nor was this the whole extent of the peculiarities with which the site of the hospital was endowed: "Besides having along one of its sides the place of sepulture above alluded to, one end of the building is conterminous with the old cathedral churchyard, which is of

large size and much used, and in which the system of 'pit burial' of paupers has hitherto prevailed. I saw one of the pits some time since, having been requested to report upon it by one of the civic authorities, who is also a manager of the infirmary, and who, having accidentally discovered what was going on, at once took steps to prevent for the future the occurrence of anything so disgraceful. The pit, which was standing open for the reception of the next corpse, emitted a horrid stench on the removal of some loose boards from its mouth. Its walls were formed, on three sides, of coffins piled upon one another in four tiers, with the lateral interstices between them filled with human bones, the coffins reaching up within a few inches of the surface of the ground. This was in a place immediately adjoining the patients' airing-ground, and a few yards only from the windows of the surgical wards. And the pit which I inspected seems to have been only one of many similar receptacles, for the *Lancet* of September 25th contains a statement, copied from one of the Glasgow newspapers, that 'the Dean of Guild is said to have computed that five thousand bodies were lying in pits, holding eighty each, in a state of decomposition, around the infirmary.' Just beyond the churchyard rises an eminence covered by an extensive necropolis, which, however, from its great distance, must have comparatively little deleterious influence. When I add that what is called the fever hospital,

a long four-storied building, extends at right angles to the new surgical hospital, separated from it by only eight feet, and that the entire infirmary, containing 584 beds, stands upon an area of two acres, and that the institution is almost full to overflowing, I have said enough to show that the wards at my disposal have been sufficiently trying for any system of surgical treatment. Yet during the two years and a quarter that elapsed between the Dublin meeting and the time of my leaving Glasgow for Edinburgh those wards continued in the main as healthy as they had been during the previous nine months. Adding these two periods together, we have three years of immunity from the ordinary evils of surgical hospitals, under circumstances which, but for the antiseptic system, were especially calculated to produce them."

Such was the character of Lister's triumph, achieved in the very camp of the enemy. Simpson had desired to abolish these disease-breeding hospitals. He was the reformer who destroys. Lister was the reformer who reconstructs. From wards in which the foul emanations of the dead coming through the windows mingled with the foul emanations of the living Lister established "models of healthiness."

In the summer of 1869 James Syme suffered from an apoplectic stroke. He recovered with partial paralysis, but of course felt compelled to resign his professorship. He had watched the career of his son-in-law with increasing pride

and admiration, and was the first of the old school of surgeons to recognize Lister's greatness. Lister and his wife used frequently to journey to Edinburgh, and Lister, therefore, was able to have long conversations and consultations with the great Edinburgh surgeon. Syme tried the antiseptic system in his own wards and was soon convinced of its value. In 1869 he published seven remarkable successes in the *British Medical Journal*, and brought all his powerful influence to aid the recognition of the new work. His fighting spirit was also aroused by those jealous antagonists who have always to be beaten back when a great discovery is made. Carbolic acid had been used before Lister's day to take away odours. Lister himself had had his attention drawn to its possibilities by its usage in Carlisle for these purposes. But its use to take away smells was very different to the use to which Lister put it, and the blundering attempts to put his great work on a par with the work of those who used carbolic acid as a deodorant aroused the potent wrath of James Syme to denounce those who would "filch away from Mr. Lister the credit justly due to him for devising and establishing the antiseptic system." Finally, in the last clinical lecture he delivered before his stroke, he announced with prophetic vision his faith in the younger surgeon who "is certainly destined in no small measure to revolutionize the practice of surgery."

Syme recovered from his stroke sufficiently to

once more come out in support of his son-in-law. He was emphatic in his advocacy of Lister filling the post he himself had been compelled to resign. Lister was accordingly appointed Professor of Clinical Surgery in Edinburgh University in succession to Syme in 1869, and it was consequently from Edinburgh that he published the story of his triumph.

No sooner had Lister announced this triumph than he was attacked. The first attack seems to us now more amusing than anything else. It was not until Lister had returned to Edinburgh that, in giving an account of the wonders the antiseptic system had wrought in his wards at Glasgow, he had been compelled to show how very adverse the situation of those wards had been to surgical cleanliness and success. This exposure of the scandalous site of the leading hospital in Glasgow was certainly something of a Parthian shot.

The directors of the Glasgow Infirmary were but ordinary mortals—that is to say, men so bound by habit as to be unable to see truly any great change that was taking place under their own eyes. The habit in their case seems to have been an economical one. Lister's antiseptic dressings were, of course, more costly than lint dipped in water, which constituted the common wet dressing. This expense of the dressings had somehow to be counterbalanced. By good fortune the healthy conditions of Lister's wards enabled them to effect this. They were so

healthy that with a clear conscience the directors were able to save upon the usual cleaning. " My wards have remained," wrote Lister, " during the three years without the annual cleaning which used to be thought essential. On my asking the superintendent the reason for the omission, he replied that as those wards had continued healthy, and there was nothing dirty in their appearance, it had seemed unnecessary to disturb them."

Lister, in spite of this lack of appreciation, had felt a considerable reluctance in making the true conditions of the Glasgow Infirmary public. But the bearing it had upon his discovery was too important to mankind at large to be hid. He therefore published without exaggerating, but also without minimizing, the conditions. The publication came as a shock to the Glasgow authorities, who gathered up their shoulders to meet it. They claimed that the good results in Lister's wards were really not due to Lister so much as to themselves and the attention they had paid to increased cleanliness, a claim that was sunk when Lister announced that his wards alone had been excepted for three years from the benefit of cleanliness. The directors were particularly nettled by Lister writing from the rival city of Edinburgh, and strove to throw discredit upon the place of the writing's origin by showing that in recent years their statistics for amputations had been more favourable than those of Edinburgh, a fact in reality due to the

successes of the very man whose accusations they were attempting to rebut. The phrase of Lister that he had felt it "a questionable privilege to be connected with the institution" they felt required a severe retort. With the ludicrous self-contradiction of baffled dignity the directors declared that "at all times they have been ready to receive from their medical officers any suggestions as to how the hospital could be improved, and these have never failed to receive their immediate attention," but at the same time declared that as regards the antiseptic system, the system which was to make their wards immortal in the annals of surgery, they did not think much of it as a suggested way of improving the hospital, an opinion "which is shared by those of their number belonging to the medical profession."

Lister took the opportunity, in a dignified answer to the Glasgow directors, once again to emphasize the value of the antiseptic treatment. Such an attitude was characteristic of his replies. Like Darwin, he cared nothing for controversy, being too deeply absorbed in his own discovery and widening vista of truth to stop upon the way to wrangle. The only statement of the directors that angered him at all was the one that implied that none of his medical colleagues had any faith in antiseptics. This, he said, was untrue. Mr. Macleod, his fellow-surgeon and successor to the chair of Surgery, had announced his belief in antiseptics at the meeting of the

British Medical Association at Leeds in the previous year.

Though certainly of the philosophic temperament, Lister could not leave the dissemination of his truths to the hand of time, and therefore always published them whenever occasion gave him opportunity to do so. His transfer to Edinburgh, however, robbed him for the time being of personal opportunity. He could not immediately get the new wards into the discipline and order he desired. Nurses are not less conservative than other people, and as apt to think that new ways are faddish, to be publicly professed if the chief is strict, but privately opposed and refuted. Lister had to train his Edinburgh nurses to his peculiar and troublesome ways. He had to train his house-surgeons and dressers and persuade them to take infinite care, when he was absent as well as when he was there to watch. Time also had to elapse before he had had under his charge a sufficient number of illustrative cases which would once more bruit abroad the value of the antiseptic system. He therefore was slowly collecting material for another announcement when important and unexpected testimony came from the Continent in the middle of 1870.

Dr. Saxtorph, Professor of Surgery in the University of Copenhagen, had paid a visit to Lister at Glasgow in the previous year. He had been impressed by reading Lister's reports upon compound fracture. He was more impressed by

what he saw. He saw wounds heal without devastating inflammation. He stayed a considerable time with Lister, watching every detail of the thoughtful practice. He was also a firm believer in Pasteur's germ theory.

Thus equipped he returned to Copenhagen. At the end of a year he, too, had wrought a miracle in his surgical wards. In July, 1870, he wrote to Lister the following letter :—

" My dear Sir,—It is now a year since I left Glasgow, where I had the opportunity of seeing how the antiseptic treatment of wounds is to be carried out. Every surgeon who has seen the remarkable results of this treatment must feel it his duty to imitate you, and dress the wounds after your principles. I therefore, as soon as I came home, adopted your method, and have used it now continually since that time ; and I am happy to say that, although I have not generally succeeded in obtaining complete primary union " (*i.e.*, healing of severed tissues directly by conjunction of cut surfaces without gaping), " still, the treatment has proved in other respects extremely satisfactory. The hospital to which I am appointed head surgeon (the Frederik's Hospital) is a very old building—in fact, it is now more than a hundred years old—and it contains about 350 medical and surgical beds. In the surgical wards I have room for about 150 patients ; but the usual number during the winter has varied from 100 to 130. Formerly

there used to be every year several cases of death caused by hospital diseases, especially by pyæmia, sometimes arising from the most trivial injuries. Now, I have had the satisfaction that not a single case of pyæmia has occurred since I came home last year, which result is certainly owing to the introduction of your antiseptic treatment. But it must be clear to any surgeon who has adopted your method that unless you take the greatest precautions in *every* dressing until the wound is either healed or filled up with granulations, you will never see the excellent effects of this treatment. It certainly takes much longer time, and demands much greater precautions, than any other dressing ; but the reward is certain, and it is a satisfaction to know that the good result of many operations almost entirely depends upon your dressing of the wound. . . . All the compound fractures which I had to deal with last year, some of them very severe ones, have healed without the least suppuration in the fracture itself, and the consolidation did not take much longer time than in a simple fracture. All the amputations of this year have recovered. There has certainly been some suppuration, but it never became profuse, and I never observed any putrefaction. I feel so much indebted to you for what I have learnt in seeing you employ the antiseptic dressing that I thought it my duty to let you know how things went on in my hospital practice ; and I am happy to say that

I have never tried any innovation which answered so admirably as this treatment of wounds.

" Believe me, my dear Sir, ever yours,

" SAXTORPH."

This was the first really powerful testimony to the antiseptic system that Lister had received, and was gladly received by him, he and Professor Saxtorph becoming lifelong comrades in the spread of the antiseptic doctrine. Lister published the letter, and added some words of his own upon his initial successes in the Edinburgh Infirmary. The Edinburgh wards were scarcely better than those of Glasgow. Simpson had collected a dark record of 161 deaths out of 371 amputations in ten years. Of amputations through the thigh three out of every four patients died, the surgeon sowing the seeds of death in the injured limb.

Lister purged his Edinburgh wards of all this horrible suffering and disease as he had purged his wards at Glasgow. In publishing Professor Saxtorph's letter he wrote that he had intended to wait for a longer time before publishing his results, but " I may state that, having now been in charge of fifty beds for nine months in the Royal Infirmary here, I have as yet no instance of pyæmia, although many cases have been admitted in which it might, under ordinary treatment, have been apprehended, such as compound fractures, amputations in the lower limb, and extensive gouging operations upon bone.

Hospital gangrene has also been absent. Though several cases of ulcers of long standing have been under treatment, there has never been any appearance of greyness of the surface to indicate even the mildest form of disease."

The picture of the wards had completely changed. To men of Lister's sympathetic feeling, who found the previous conditions "sickening and heartrending," the new picture must have been wonderfully gratifying. The air of the wards was no longer burdened with a sweet fœtidity, nor at the time of the dressing of the wounds was it charged with a heavy stench. A faint odour of carbolic mingled with the wholesome air, which, blowing from the Pentland Hills, bore to the patients the health of moor and mountain. In place of the odour of corruption and death there was the association of recovered health with the plenitude of golden gorse, the quivering bells of heather, and white clouds in broad movement across the blue sky. Instead of the wan, pinched faces, the feverish and restless glitter of eyes searching hither and thither in vain for help from agony endured, instead of the skeleton hands plucking ceaselessly at the quilt or tremulously fingering and feeling as if for a thread of hope, instead of the gaze staring blankly at the ceiling and watching hour by hour for the expected vision of death, instead of the groans of suffering and the prolonged and piercing cries called forth by the fiery tortures of gangrene, Lister in visiting his wards saw

faces, often no doubt of suffering, but rarely, if ever, without hope, more often radiant with hope. He heard voices, no longer groaning with intolerable woes, but answering his grave and gentle inquiries with accents of a gratitude that could scarce be uttered; for to those who had cognizance of the miracle he had wrought and of which they were the first recipients he must have seemed something more than human in his gifts and quality.

In the midst of his great triumph Lister preserved, unstained from the breath of vanity, the noble qualities of character that were his. He was ever gentle, courteous, and firm. Trying as are the exactions and responsibilities of an important surgical post, Lister was never known to speak a sharp word to house-surgeon, dresser, or any one in his service. His scientific spirit and discovery attracted the curiosity of the students and young graduates of Edinburgh; his personal nobility won their hearts. His art of winning their loyalty was by inspiring enthusiasm and giving encouragement. "Often in the middle of a trying operation," wrote one of his pupils, "a gentle smile bestowed on us young students when we were honestly trying to do our best as assistants was most encouraging." Many of his students afterwards confessed that their contact with Lister was the best and purest influence of their lives.

For Lister's triumph was not a triumph of intellect only or of any separate faculty of man.

It was one of the whole man, to which the character that won reverence was as essential as the victorious intellect. Had not Lister cared deeply for his suffering patients he would never have showed such a plenitude of power in their behalf. He possessed every quality of the greatness that alone can dispense the greatest of gifts to man. He had the calm self-reliance and self-consciousness of superior gifts, which are founded on fact and not on false pride, and which make a great man shy in that he strives to conceal and not advertise his easily excelling quality. From all baser elements, such as petulance, hesitation, discursiveness, which belong to the moment rather than the length of years, he was free. He lived and worked with the serenity and patience that belong to those who know that their lives and work are based upon the unchanging truths of nature and not upon the opinions of their fellow-men. For the same reason he possessed an unalterable will. Gentle to those who served him and were placed in his charge, he was unyielding in their defence, in devices for their good, in efforts for their tuition, showing the parental quality that in a supreme type constitutes the powerful beneficence of genius.

The sonnet of Henley the poet, who was Lister's patient in the first weeks of his Edinburgh professorship, beautifully described these qualities and gave a picture of Lister that no other pen could attempt to equal. It was entitled

"The Chief," the name by which Lister was fondly known.

"His brow spreads large and placid, and his eye
Is deep and bright with steady looks that still.
Soft lines of tranquil thought his face fulfill—
His face at once benign and proud and shy.
If envy scout, if ignorance deny
His faultless patience, his unyielding will,
Beautiful gentleness and splendid skill,
Innumerable gratitudes reply.
His wise, rare smile is sweet with certainties,
And seems in all his patients to compel
Such love and faith as failures cannot quell.
We hold him for another Heracles,
Battling with custom, prejudice, disease,
At once the son of Zeus with Death and Hell."

CHAPTER VIII

THE SPREAD OF THE GOOD TIDINGS

THERE is a popular opinion that that which is known as science has the peculiar quality of endowing its devotees with an ability to resist the foibles, follies, and vanities of mankind. One may nowadays attack theology with contumely and scoff at dialectical subtleties too delicate for one's grasp. But science is secure and impregnable. The reverence of the people has confirmed it as powerfully against assault as in the past they confirmed theology. It is now a greater sacrilege to criticize science than to criticize dogma, and science imposes upon its priests a greater infallibility than theology now bestows upon its priests. Subscriptions and donations from the faithful pour in freely, and the monastic seclusion of the laboratory replaces that of the cloister. Temples to science are erected throughout the land, its fanes flourish and multiply, while the abbeys and churches fail. And all is the result of a profound faith in an abstract and impersonal thing that is held to possess mysterious power for human good,

namely science or the scientific method. Yet nothing is more certain to the philosopher than that mankind is unchangeable in its first principles, and that it is upon personality that all is really based.

When theology was in the hands of powerful and generous natures, then the benefits and blessings which flowed from it to the mass of men were unquestionable. The dogmas in their profundity answered some of the strange needs and passions of the profounder souls; in their more superficial reading they brought comfort to countless men and women, provided they were vitalized by the living presence of strong and generous dispensers. In the hands of meaner people the dogmas took upon themselves a meaner aspect, and meaner dogmas themselves came into being. It was not upon theology that mankind's consolation and profit depended, but upon the type of men who held power and found in theology a fitting means of interpreting their actions to the people and guiding them.

It is precisely the same with science. The benefit that mankind derives from science is dependent, not upon science itself or the scientific method, but upon the greatness of the men who make science the medium through which they dispense their own generous power. In the hands of a great man capable of getting that mastery which makes a matter previously complex and beyond man's control described by the word "simple," science bestows great benefits.

In the hands of lesser men its benefits are less; they tend, indeed, to become no benefits at all, but the offspring of weakness. A great accumulation of the mediocre arises, an accumulation which seems to be an inevitable part of the plan of Western civilization, an accumulation which would choke us with disorder and complexity, the signs of mediocrity, unless some greater man came and once more reduced superfluous complexity to simplicity. For the world of the West is perpetually becoming encumbered with a superfluity of the commonplace and perpetually in need of the selecting and simplifying power of the genius. The scientific work of commonplace men ought not to be regarded with gravity, as if somehow science itself lifted it above the commonplace and conferred upon it a peculiar sanctity. A commonplace workman if left to himself produces a commonplace article, and it cannot be that science *per se* lifts similar work to a higher plane. This uplifting power science is certainly supposed to possess, and its possession is as certainly a delusion that has gathered about science to the detriment of both scientists and people. It is a belief likely to lead to as black and bottomless quagmires as those to which a like belief in theology led. The modern world is already hampered and encumbered by a vast accumulation of disordered stuff of commonplace quality with a fictitious value owing to it being named "science."

It is only when the relation between ordinary

men and the genius is one of faith on the one side and parental generosity on the other that genuine profit to mankind results. It is only when the ordinary man or priest is carrying out the dictates of genius—and not the methods and processes agreed to by an assembly, who think numbers constitute power—that genuine profit to mankind follows. Sound tradition is always the handing on from generation to generation of the one-time creative, simplifying, and ordering power of genius. It is the best and soundest form of ancestor-worship; and when a genius makes out of confusion order and out of disaster success, then so long as that tradition is faithfully preserved and followed by its priests, so long does mankind continue to reap the benefits of the peculiar power of genius. Lister, with the whole outlook upon and minute application of first principles, established and proved that that which before had been unmastered was now mastered. He had given a reason for his success, one which will perhaps be found by some future genius to require new shape and interpretation, but nevertheless one which gave a guidance to the ordinary man and linked up his acts of treatment in a sensible whole.

It was this: Certain germs under present conditions, and especially under hospital conditions, caused certain diseases if they got access to injured tissues. Certain chemicals, amongst which the best was carbolic, if applied to these germs, killed or at least so altered them that they

could not cause disease. The object at which to aim was never to allow any germ to get to the injured tissues, whether conveyed by the air, the surgeon's or dresser's fingers, the instruments, the dressing, or from the patient's skin in the neighbourhood of the wound, without it first having been soaked in carbolic and rendered innocuous. If, however, it did reach the wound, then in the wound itself it was to be soaked with a solution of carbolic or other chemical having similar powers. Then when once the wound was free from germs it was to be covered with a protective screen or dressing of carbolic, so that no germ could get to the wound without passing through this screen and becoming carbolized in transit.

Such was the faith that Lister had to found. He had to prove it by that which always connects genius with mankind, namely, practical results. In other faiths it is the same. It is the practical result of material benefit, sense of comfort, feeling of things previously unintelligible becoming intelligible, the consequent feeling of increase of the understanding and mastery of life that convince. It is, in short, the individual's share in the power of genius that convinces him. It is essential, therefore, for the genius to provide a brief and intelligible creed and a definite ritual for other men if the faith he founds is to be profitable in good results to mankind. From this ritual only those can deviate with safety who have as clear a grasp of first principles

and their application as the founder. Such men are, of course, exceedingly rare. In the matter of antisepsis there were and have been none approaching Lister, and his guiding work has never required revision.

The first step towards the general establishment of this ritual was auspicious. Soon after Lister's publications of his results in cases of compound fracture and chronic abscess, he found an influential advocate in James Goodchild Wakley, the youngest son of Thomas Wakley, the founder of the *Lancet*. James Goodchild was editor of the *Lancet* at the time when Lister was promoting his doctrines. The paper had been founded by his father to attack the selfish exclusiveness of the leading medical men in London, who made a ring of medical information, and who, through flagrant nepotism, kept all the good hospital appointments in the circle of their families and friends. The elder Wakley's attacks awoke fierce antagonism, and Wakley himself was many times called to the courts of law to answer the charge of libel, cases in which the victory usually laid with him. His son James Goodchild was a man of much gentler nature; he was broad-minded but non-combative. As leader of the journal which his father had made the chief medical paper, Wakley was important to Lister, and Lister was fortunate enough to secure his advocacy. But though favourable, Wakley's voice was a gentle one, and its tones were not far-reaching or powerfully convincing. It had

none of the thunderous quality or combative independence that his father's possessed.

The elder Wakley died when Lister was commencing his work. Had he lived and championed antisepsis, the fame and merits of the treatment would have reverberated throughout the British world, and the ears of the profession, whether approving or disapproving, would have been forced to hearken. The advocacy of the son was discerning, and showed a realization of the vast possibilities of Lister's work, but it lacked the force and perseverance of the conviction of a strong man. In later years the jealousies that existed between London and Edinburgh and London and Germany were sufficient to turn the same advocacy into petulant antagonism.

Lister published his first successes in cases of compound fracture in the *Lancet* of 1867. These successes were clearly unique, and merited a leading article. Nevertheless, knowing the incapacity of men to measure the value of the new, the fact that Wakley devoted a very favourable leading article to them showed that he possessed a discrimination notably lacking in the leading members of the profession.

" If Professor Lister's conclusions with regard to the power of carbolic acid in compound fractures should be confirmed by further experiment and observation, it will be difficult to overrate the importance of what we may really call his discovery." After a reference to Pasteur's work,

the writer continued: "It is lamentable to think of the extent to which the best and most refined surgery of the time is being frustrated in our great hospitals, and even in those but lately built. The mortality of compound fractures, of the graver amputations, of lithotomy in our larger hospitals, both provincial and metropolitan, is something frightful. And the occurrence of death with symptoms of blood-poisoning is, unfortunately, not confined to cases of serious operation, but happens ever and anon after operations in themselves slight. The risk—the risk of blood-poisoning—is, indeed, now the one great opprobrium of surgery."

Here there was a clear recognition of the curse of hospitals and the possibility of its abolition. One wonders that such a vision did not inspire a warmer and more pertinacious championship. But Wakley's recognition was apparently an intellectual one, and that peculiar bodily vim, or whatsoever it may be, that is needed to convert a sympathy to a conviction was lacking. For the space of three years the personal voice of the *Lancet* in regard to Lister was mute.

With the exception of the *Lancet* editorial, the first notice with which the profession publicly favoured Lister was a letter from a private practitioner, reporting a single favourable case under antiseptic treatment. This was a month after the *Lancet's* editorial. The next professional notice quickly followed, and took the form of

an anonymous letter attempting to take away from Lister the merit of originality in regard to the use of carbolic and to give the credit to a Parisian surgeon, Dr. Lemaire.

This method of initial recognition called forth a reply from Lister. To the accusation that his work possessed no originality he paid little heed, but he took the opportunity afforded him, not for personal claims or defence but once more to press the value of antisepsis and to indicate the errors of faith and treatment into which practitioners were likely to fall. The letter is, in fact, notably illustrative of this singularity of aim undeterred and undeviated by any momentary personal vanity, which distinguishes Lister and enables one to read the power of his character in the words he penned.

" I have seen Dr. Lemaire's work on Carbolic Acid," he wrote, " and find that where he speaks of surgical applications of that substance, the principles and practice which he mentions are such as sufficiently to explain the insignificance of the results. I may repeat that I never claimed to have been the first to use carbolic acid in surgery. The success which has attended its employment here depends not so much on any specific virtue in it as on the wonderful powers of recovery possessed by injured parts when efficiently protected against the pernicious influence of decomposition. I selected carbolic acid as the most powerful of antiseptics, but I think it is not unlikely that my object might

have been gained by using, on the same principle, some other 'disinfectant.' And I may take this opportunity of warning some of your readers that they must not expect carbolic to act like a charm, but that, whether they employ this agent or some other of analogous properties, it is only by the light of sound pathology and strict attention to practical details that they can hope to attain in their full measure the magnificent results which the antiseptic treatment is capable of affording."

The next professional notice of Lister's work was from his great contemporary Sir James Simpson. Simpson knew from bitter experience how hard was the path of an innovator. His great discovery of the anæsthetic powers of chloroform had brought down upon him a rain of attack. The clergy had been incensed with a man who was presumptuous enough to take away the pain that Heaven had sent to try or punish mortals, and protested above all against the mitigation of the pains of travail in which women were doomed from the beginning to bring forth children. Simpson had, however, little difficulty in silencing them with the powerful retort that, in the first operation ever recorded, God caused a deep sleep to fall upon Adam. Simpson was also attacked by his professional brethren, if they who are oppugnant may be called brethren. Simpson defended himself, not only with the statistics resulting from his work, but also by showing how the introducers of mercury,

antimony, quinine, and other benefits had suffered from attack, and how the revered Jenner himself had had to endure bitterness and ridicule before sluggish judgments were convinced that what Jenner had done could be repeated. Moreover, quite recently Simpson had had to meet an attempt to prove that his original method of stopping hæmorrhage, which he named acupressure, was nothing but a plagiarism, little creditable to him, who had clothed an old method " in all the glittering charms of novelty."

Here, then, was a man who could appreciate the stony path of the bringer of glad tidings, who finds himself at first ignored or slighted, and then, when his discovery forces its way into notice, finds people eager to prove that he has been anticipated and is strutting in borrowed plumes.

But, great man as Sir James was, he cannot be said to rank amongst the greatest. There is a definite measure to men's greatness, and they may be placed first who are able to put their judgment above personal considerations, because they know their personal power stands above that of others and cannot be surpassed. Sir James felt he was being surpassed. He had held a supreme position for so long that the noble quality of service and loyalty to one greater than he, a quality placing man next to the greatest, was rendered difficult to him by circumstance as well as character. It was certainly as a rival he regarded Lister, whose work threatened to

annul his work both on hospitalism and the means of stopping hæmorrhage. Nevertheless, courteous and generous rivalry is no great detraction from high quality, though the highest have always pursued an object without wasting their strength upon personal jealousies. What, however, does place Simpson upon a lower level than the greatest scientists of the last century, such as Darwin and Lister, is the fact that he did not attack Lister upon his own ground—that is to say, upon the principles, methods, and results of antisepsis.

Such an attack would have been fully justified if it could have been made. If Simpson had repeated Lister's experiments exactly, and had found them fail or dubious, then he could rightly have attacked Lister. Or had he pitted results obtained from some other method against Lister's and kept the contest within such a ring, then, again, he would have been justified. He had such a method in acupressure, and he did pit his acupressure against Lister's antisepsis. But he did not do so until he had filled four and a half columns of the *Lancet* with an elaborate proof of what Lister had never denied—namely, that other surgeons had, previous to Lister, made use of carbolic acid. In short, Simpson attacked Lister on the inferior level which regards the personal vanity that quarrels about precedence as important, and thereby proved himself the inferior man.

There was, indeed, plenty of ill-concealed

jealousy in this attempted disparagement of Lister, for which purpose Simpson had singled himself out amongst all the members of the profession. He began by quoting Professor Hingston, of Montreal, who " had found the use of carbolic acid was now being discontinued in places where formerly it was in vogue "—a piece of information which, in the light of latter-day knowledge, is no great testimony to the acumen of Lister's predecessors. Professor Hingston sneered at Lister's treatment in so able a manner that Simpson was glad to borrow it by quotation to show his own feeling towards Lister : " While in Great Britain he had seen it poured into and over the surfaces of recent amputations and other wounds, in the form of fluid ointment or combined with oil, in a way which recalled to his mind the older and reprehensible system of dressing with some foreign body the whole raw surfaces of recent wounds—a practice that was followed two or three centuries ago, and which he fondly hoped was for ever banished from scientific surgery."

By choosing such a quotation as a start Sir James Simpson showed his jealousy of Lister clearly enough. Simpson, having used Professor Hingston to prove that continental surgeons were giving up the use of carbolic, then set to work to show that, even were there any value in carbolic, at least the credit of using it belonged to these surgeons and not to the Glasgow professor, whose work threatened to make

his work on hospitalism and acupressure mere wastage.

The chief of these, the aforesaid Dr. Lemaire, Sir James declared had bestowed great thought and attention upon the use of carbolic acid, and, he added politely, "in that respect, as well as originality, leaving Professor Lister very far behind him. On one or two points—but these of a most doubtful character—Professor Lister goes, perhaps, farther, for he seems actually to believe that the use of carbolic acid may lead to the absorption of a piece of necrosed bone, or a silk ligature when cut short and left in a wound—a kind of surgical belief in which I think he will get few or no disciples to join him at the present day."

There was the rub. Simpson saw that if Lister could make the ligature safe his acupressure invention for stopping bleeding was doomed. He had spent ten years of thought and experiment upon acupressure; he had recently given it to the world, and it had been hailed at the Dublin meeting of the British Medical Association held in the summer of 1867 with far greater enthusiasm than antisepsis. Yet Simpson saw already the danger of the younger infant throttling his own. He was not a man great enough to set truth above feelings of personal vanity. His claims in previous years of the superiority of chloroform over ether as an anæsthetic greatly exaggerated the advantages of the drug whose powers he had discovered. A similar passion

for his own stirred him in these last years of his valuable life. This parental jealousy appeared clearly at the end of his article against Lister. With acupressure, he declared, ligatures were no longer needed. Wounds could be sewn up and suppuration avoided. He quoted the good results which Professor Pirrie, of Aberdeen, had obtained with acupressure, a position in an article of rancour not wholly pleasing to the Aberdeen surgeon, for the very next week he published successful cases in favour " of Professor Lister's original communications on the use of carbolic acid." Why, then, was Simpson's final question, did not Lister introduce acupressure into his Glasgow wards instead of trying to redeem the already discredited ligature by means of carbolic?

Lister, of course, had to reply to so notable an opponent. His answer was admirably terse and calm, in contrast to Simpson's envenomed effusion. Upon the subject of Dr. Lemaire's use of carbolic and his own he had already written. Upon the subject of antisepsis and the ligature he would again write when his new material was ready.

" Sir [he wrote to the editor of the *Lancet*, in whose paper Simpson's attack had appeared], —The elaborate communication of Sir James Simpson in to-day's *Lancet* may seem to require some reply. But as I have already endeavoured to place the matter in its true light without doing

injustice to any one, I must forbear from any comment on his allegations. In the forthcoming numbers of your journal I have arranged to publish, with your permission, a series of papers fully explanatory of the subject in question, and your readers will then be able to judge for themselves how far the present attack admits of justification.

" I am, Sir, yours, etc.,

" JOSEPH LISTER.

" Glasgow, Nov. 2, 1867."

Such a laconic reply scarcely permitted Sir James Simpson himself again to enter the lists. Another champion had to be found, and was discovered in Mr. Ricketts, of Liverpool. Mr. Ricketts praised acupressure and supported the fiction that Lister was only reviving what others had tried and abandoned. " Why give credit," he wrote, " to the reintroduction of an obsolete and inelegant plan, when so simple, effectual, and elegant a method as acupressure obtains such magnificent results? "

A month passed and then two practitioners wrote in defence of Lister, both of them declaring that under their own eyes he had secured " startling results " by his mode of using carbolic. If, said they, Sir James could produce any surgeon who had by means of acupressure got equal or better results previous to Lister, then Simpson and his surgeon, and not Lister, deserved the chief credit in disposing of the problems of blood-poisoning and ligature.

This, of course, Simpson could not do. His attack had been ungenerous and at fault. But it had one excellent result. It brought the greatest surgeon of the day into the field, James Syme, angrily lashing at those who tried, " anonymously and otherwise, to filch away from Mr. Lister the credit justly due to him for devising and establishing the antiseptic system," and throwing down the challenge of his seven wonderful successes with the employment of the antiseptic method. This, with a report of a successful case by Mr. John Macclatchy and some half-hearted and equivocal testimony from Mr. Timothy Holmes, the editor of the famous " System of Surgery," completed the strange story of the first year of the reception accorded by the profession to Lister's transforming work.

The next two years showed a notable neglect of attention to the practice of Lister's antisepsis. The attacks upon Lister's originality had failed, and the interest in his results waned. A few doctors from Scotland, Ireland, or the provinces wrote or spoke in praise of Lister's methods, but the interest was very lukewarm and provoked no controversy or general discussion of the merits of antisepsis. Dr. Coats, of Glasgow, called in one of Lister's assistants to a severe case of compound dislocation of the ankle-joint, and was enamoured with the result of the treatment. Mr. Tyrell, of Dublin, found carbolic of " the greatest service." Mr. Hamilton, of Liverpool, emphasized the certainty of success if Lister's " defined

principles " were followed. Dr. King, of Hull, was enthusiastic as to the value of carbolic in cases of amputation. Mr. William MacCormac, of Belfast, " modified " the method, but was led by his success to a complete acceptance of Lister's theory. Mr. Rutherford Ryley, who had studied with Lister for two years before the days of antisepsis and " knew him to be a philosophic surgeon," wrote from Westland, the strip of climbing land that separates the Pacific from the wild gorges and precipices of the New Zealand Alps, that in three cases of compound fracture amongst adventurers exploring these inhospitable regions for gold he had had " striking " success with antisepsis. Mr. Wylie, another of Lister's pupils, wrote from Java to say how successful antisepsis had been in the tropics. Dr. Rose, of Kidderminster, and Mr. Bartlett, of Birmingham, reported successes with enthusiasm. But the only surgeon of considerable repute to support Lister was Mr. Bickersteth, of the Royal Infirmary at Liverpool, who declared antisepsis to be " an immense step towards the perfection of our art."

The most experienced and weighty testimony came from Mr. Cresswell, senior surgeon to the Dowlais Iron Works in Wales. In these works over 8,500 people were employed at labour not infrequently punctuated with accidents. Mr. Cresswell carefully studied Lister's methods and applied them to his patients for a twelvemonth. At the end of that time he summed up his

experience: "The use of carbolic acid in the treatment of wounds and compound fractures has created quite a revolution in the surgical practice of the Dowlais Iron Works; for the last twelve months I have used it extensively in the treatment of the varied injuries that are of constant occurrence, and I think I may say in every instance with marked success."

This testimony called forth Mr. Wakley once more to his gentle championship of Lister, he being appalled by the ravages of sepsis which were still unabated in the great London hospitals. "Mr. Cresswell, whose surgical experience is very great, says that the use of carbolic acid in the treatment of wounds has revolutionized surgical practice in Dowlais. And yet Mr. Lister's treatment does not find much favour in London. Are the conditions of suppuration different here from those in Glasgow or Dowlais? Or is it that the antiseptic treatment is not tried with the care without which Mr. Lister has always pointed out it does not succeed?"

The record of London surgeons in these first years of the unfolding of Lister's doctrine was, indeed, a miserable one of jealousy and arrogance. The provinces, Ireland, and Scotland, as the previous pages have shown, had come forward, not in great numbers it is true, to bear testimony to the human value of antisepsis. The London medical world, however, possessed the London characteristic of haughty indifference to anything it had to accept humbly from without.

Secure in the pride of size, London then, as now, only showed favour to the gifted when by their service and presence they acknowledged her pre-eminence and added to her hereditary grandeur. It was for merit to come to London and sue her favour and patronage, and not for London to bend humbly in service and loyalty to merit, however great it might be. The surgeons and hospital staffs of the London hospitals were clothed with this peculiar spirit. Until Lister himself came and took up his work in London—an event which will be recorded later—London surgeons seemed to be barricaded against his truths by an almost monstrous conceit.

In a profession whose ethics rightly demand the immediate gift of any discovery made by one of its members, which is likely to benefit mankind, and its probation by its leading members, the duty and necessity of testing Lister's method was one that could not be avoided and could only be postponed by men of defective quality. Only one London surgeon, however, showed himself to possess a character of generous discernment that was not limited by a local spirit. Mr. Berkeley Hill, of University College Hospital, came from a family whose members were as notable as those of any family in England for their ability to view the public benefit with eyes unclouded by personal feeling or sectarian prejudice. He had himself fought a fearless fight in favour of the Contagious Diseases Act, and had endured much obloquy and malice in

consequence. He alone of all the surgeons of London greeted Lister's discoveries in the spirit in which they should have been greeted, and were supposed to be greeted, according to the high standard of the profession's ethics.

Mr. Hill did what was obviously the right and proper thing to do. He went to Glasgow and personally watched Lister's methods and results. In January, 1869, seeing how little progress was being made in London and how none of the leading surgeons followed his example and made themselves personally acquainted with Lister's work, Mr. Hill declared boldly before the Harveian Society that the reason why London surgeons failed so totally in their trials of the antiseptic system was that they had not taken the trouble to find out what the antiseptic system, as devised by Lister, really was. It was useless to attempt to reproduce Lister's successes unless they first reproduced his principles and methods. To indulge in variations before the original theme had been mastered could not result in anything decisive or beneficial.

The London surgeons in particular refused any countenance to the germ theory of putrefaction, without a belief in which Lister had said that "no man can be thoroughly successful in treatment," for "without this guiding principle many parts of the treatment would be unmeaning; and the surgeon, even if he should attempt the servile imitation of a practice which he did not understand, would be constantly liable to deviate from

the proper course in some apparently trivial but essential detail, and then, ignorant of his own mistake, would attribute the bad result to imperfection of the method. For my own part, I find that, in order to approach more and more to uniform success, it is necessary to act ever more strictly in accordance with the dictates of the germ theory. Failure on the part of those who doubt or disbelieve it is therefore only what I should expect."

Ignoring the philosophy of the antiseptic system, the London surgeons could not accept antisepsis as a creed and practice. They limited it to a mere routine application of carbolic acid. They, in fact, not only showed indifference to the germ theory which Lister held to be essential, but they also fell into another error, which Lister had foreseen—namely, looking "upon carbolic in the light of a specific." This they did. They accepted carbolic acid from Lister, and as regards its use did the thinking for themselves, and used it incidentally as a substitute for the water of the conventional water dressing or water sponging. The result was the successive failures and consequent very indifferent approval which provoked Mr. Wakley's irony and Mr. Hill's admonition.

Mr. Wakley himself sent one of his reporters to find out all about antisepsis in London. He reported at the turn of the year from 1868 to 1869 that Lister's methods were being frequently adopted "with modifications at the fancy of the

surgeon." He tried to discover the leading opinions. Mr. Rouse, of St. George's, was impressed by a case of compound fracture, in which the patient unfortunately died of heart failure too soon to enable the surgeon to form a definite judgment. The surgeons at Middlesex Hospital used carbolic, but " with a view quite different from that entertained by Professor Lister." At St. Bartholomew's Mr. Paget said of Mr. Lister's carbolic that " in the few cases he has tried it it has been useless," possibly from faulty application. Mr. Coote did not approve of " Lister's method, which he considers meddlesome." Mr. Birkett, of Guy's, boasted the unusual experience that cases did " very well on the usual plan," but Mr. Bryant found the results upon the whole good, and this due " in a great measure to the use of carbolic acid." Mr. Wood, of King's College Hospital, used carbolic acid *pari passu* with the old dressings, and his results were correspondingly equivocal. Mr. Barwell, of Charing Cross Hospital, used his own modifications with modified results, and considered the methods of Lister " require much time in their application," and such an experience as he had had " does not encourage him to expend much time on them." Mr. Maunder, of London Hospital, was decidedly favourable, and reported two successful cases of ligature. Mr. Holt, of Westminster Hospital, was also favourable, though success seemed to him a good fortune rather than a certainty.

Mr. Wakley was gravely disappointed with this mixed and indecisive record, and took the earliest opportunity that occurred, in a comment upon one of Lister's papers, to record his feelings. "Whether surgeons," he wrote, "accept Mr. Lister's conclusions or not, they must admit the candour with which he reports all details of his experiments, and the scientific strictness and severity with which he observes phenomena. His paper last week is far more than a mere contribution to practical surgery. It enlarges our idea of life and the extent to which the living tissues may be made to assimilate organic substances. And it is a perfect model of the way in which a practical art may be advanced by sound minute physiological observation. . . . When we compare Professor Lister's results and conclusions," the writer continues in an ironical vein, "in regard to the antiseptic principle, with those of other surgeons, it is impossible not to be struck with the difference between them and him. The physiological phenomena described by him are something most unusual: almost entire absence of pus and of signs of inflammatory thickening, and the incorporation of ligatures used with living tissues, are results very different from the coarse and tedious processes of old surgery. But it will be objected they cannot be obtained by other surgeons. Be it so. All that we can say is that they are obtained by Mr. Lister."

Meanwhile how did Lister deport himself

towards this envious and feeble acceptance of his great gift? We have seen in what manner he answered Sir James Simpson. He followed the same principle throughout. He continued quietly with his work, knowing full well that it was of such character as would eventually force the profession to follow his dictation. Once only he felt compelled to expose the bad method with which Mr. James Paget had secured bad results and had then announced the uselessness of the method "which has been so strongly recommended by Professor Lister." Had this announcement "proceeded from any one less deservedly eminent than Mr. Paget," wrote Lister, "I should not have felt called upon to notice it. But as anything from such an authority is calculated to have great influence with the profession, I have felt reluctantly compelled to allude to this matter thus publicly." He then briefly showed that Paget's method, whatsoever else it was, was "certainly not in accordance with the antiseptic system."

Though the London surgeons were indifferent and obdurate, an opportunity came for a general testimonial to Lister. The meeting of the British Medical Association was held in the summer holidays in 1869 at Leeds. Mr. Nunneley was chosen to give the address in surgery. The leading members of the profession gathered to listen to him. At no time did they meet in such numbers; at no time could a public record of the professional attitude towards the transforming

work of Lister more strikingly and suitably be given.

Mr. Nunneley recognized his singular opportunity and delivered his testimonial with the pompous clumsiness of a weak man who feels strong owing to the presence of a large and favourable gathering. He accused Lister of stupidity. "The theory and reasoning by which the antiseptic treatment of wounds is supported appear to overlook facts open to all the world, to disregard observations familiar to every person through all ages from the earliest period to the present day." The words are verbatim, and though they are intended to be large and sounding, clearly lack the bite of power. Some fatal fallacy, Mr. Nunneley felt sure, lay at the bottom of Pasteur's and Lister's work. "We may probably with safety deny the existence of germs in the number and universality maintained by Pasteur and Lister." The whole theory of antisepsis was not only absurd, "it is a positive injury." "During the last three years," said Mr. Nunneley proudly, "since the antiseptic treatment has been in vogue, I have not allowed one of my patients to be treated with carbolic acid." His colleagues had made use of it, but were now beginning to abandon it. "Its use, in fact," concluded the speaker, "has become the exception and not the rule. . . . I have spoken plainly on the antiseptic treatment because I have felt decidedly."

This anathema from the very centre of repre-

sentative surgery loosed the tongues of bitterness. Lister's antiseptic method was called "a return to the dark days of surgery," though one wonders when the shadow of death was deeper than at that time. It was called the "carbolic mania," "the latest toy of the medical profession," and it was said there was even "a professional criminality . . . in putting forward such specious doctrines as the carbolic theory."

Secure by now in his results and having his cleansed wards in the Glasgow Infirmary before his eyes, Lister remained unperturbed. Mr. Nunneley's attack from the annual throne of surgery he could not, however, wholly ignore. He replied, therefore, with the quiet irony of the strong man :—

"Mr. Nunneley's recent attack" (he wrote to the editor of the *Lancet*), "seems to me little calculated to impede the progress of the antiseptic treatment; nor do I feel called upon to point out in how many respects he has misapprehended my published views. That he should dogmatically oppose a treatment which he so little understands, and which by his own admission he has never tried, is a matter of small moment. But I was grieved to find him stating that his colleagues who had adopted the system were now abandoning it as untrustworthy. It was therefore with much pleasure that I received a very different account of the matter in a letter from Mr. Teale, in a letter which,

with his permission, I now request you to publish.

"I am, sir, your obedient servant,

"JOSEPH LISTER."

Mr. Teale's letter to Lister ran as follows:—

"MY DEAR SIR,—May I call your attention to the attack upon the 'antiseptic treatment' in Mr. Nunneley's surgical address, in which he quotes the experience of his colleagues as unfavourable to it.

"I think it is due to yourself to inform you that Mr. Nunneley was in no sense justified in making such a statement; that we still use, and have as much confidence as ever in, antiseptic treatment; and we hope shortly in some way or other to have Mr. Nunneley's misstatement corrected.

"Any want of success in our practice may fairly be attributed to imperfection in carrying out your rules.

"Yours truly,

"T. PRIDGIN TEALE."

The voice of the guilty conscience is often unduly loud. It seems as if Mr. Nunneley had striven hard to blind his eyes to the successes of his junior colleagues with the use of a treatment which he himself deliberately withheld from his patients.

In the midst of this discussion, in which

human frailty displayed itself in the immaculate atmosphere of dispassionate science and even acknowledgment sprang from the cold sources of the intellect, it is pleasing to record the personal relation and bond that is the mark of true discipleship.

"Last August," wrote a Dublin practitioner in October, 1869, "I had the pleasure of meeting Mr. Lister in his wards, when I came to the following conviction: that the aspect of the patients; the appearance of the sores and wounds; the fresh, healthy atmosphere of the wards; the absence of any smell; the quiet, impressive, unobtrusive, almost retiring, manner of the professor; his labour and painstaking in explaining, first his theory, and afterwards his mode of application and progress through every step, and their results, can only be understood or appreciated by a walk round that splendid institution with him through his wards, and also through those wards which are not under his care, and where the treatment is not so accurately or not at all carried out."

But the Pharisees of the south continued to show indifference to the wonders that were being wrought in the north, or else they continued the appalling wastage that results from abstract debate and controversy and was so unfortunately common in those days, even though a few hours in the railway train would bring a surgeon the incomparable benefits of personal contact and the witness of his own eyes. Mr. Wakley alone

seemed to be convinced of the need of the direct personal element being placed in a paramount position if the question was ever to be treated with justice. "We have no reports of anything like similar pains being taken in any of our London hospitals," he wrote, "while we have reports which show how great is the need of some such agent. Let Mr. Lister's processes be carefully carried out by trusted pupils of his own in some London hospitals. Only some such experiment as this will satisfy all parties; and in the interests of our large hospitals and of humanity, the sooner such an experiment is tried the better."

The editor of the *British Medical Journal* joined Mr. Wakley in advocacy, and sent a special reporter to the north. "Be the germ theory true or false," was the conclusion, "the excellent results of Mr. Lister's treatment are certainly such as one does not expect to find in London hospitals."

A few months later, as London had not stirred, the *Lancet* once more broke forth in protest: "The letter of Dr. Saxtorph, Professor of Clinical Surgery in the University of Copenhagen . . . makes it impossible that this question can rest where it is. The averments on the one side are so strong and remarkable, and the incredulity of the English surgeons is so general that some decisive steps should be made to come to a scientific decision."

Nevertheless this urgent experiment in a

London hospital was not carried out for another seven years, and then the experimenter was no other than Lister himself, forced to leave his friends and practice in the north by a sense of the imperative necessity of overcoming the obduracy of the surgeons of London.

In that time, as will be recorded, Lister won the leading surgeons of Germany and France to his side, and was accorded by them and their students and their friends in high positions other than medical, triumphal greetings such as, as a rule, only sovereigns have enjoyed. But in London patients continued to suffer the agonies and fatalities of all the foul and cruel forms of blood-poisoning. The means to save these unfortunates were at hand. To secure them London surgeons had only to put aside their conviction that no good thing could come out of the smaller universities of the north and humbly to follow and acknowledge the great genius who was transforming surgery from a practice that bred and spread the seeds of virulent offence to one of beneficence. It was, however, to be their lot to share with their American brethren the distinction of being the last to acknowledge the extraordinary powers which Lister was prepared and able to place in the hands of surgeons.

Such is the record of the early spread of the good tidings.

CHAPTER IX

EDINBURGH

THE send-off that the Glasgow medical men gave to Lister was not brilliant. They had had the greatest of surgeons in their midst for nine years and for the most part failed to recognize him, or had covertly or openly opposed him. His successor to the Chair of Clinical Surgery, Mr. Macleod, had spoken favourably at Leeds of the use of carbolic, and after Lister's departure continued to make use of it. But he did not base his use of it upon the germ theory, but held to the old faith of occlusion, which preached that if air were kept from a wound all would be well. With oxygen, the element of all combustion, air had for long been held to be the originator of the heat of inflammation. The effects of carbolic were adapted to this theory by declaring that the film of coagulum which the acid formed upon the injured tissues screened them from the air. Based upon this theory, it was to be expected that Mr. Macleod's results bore no comparison to those of Lister.

One or two practitioners in Glasgow had been convinced by what they had seen in Lister's

wards, but they were the exceptions. On the other hand, amongst the younger members of the profession who had come under Lister's influence a very different effect had been produced. He was their chief and teacher, and neither their colleague nor their rival. His pre-eminence over them was, therefore, taken for granted and required no generous acknowledgment of his superior gifts. They were consequently able to judge of Lister free from all personal bias except of the favourable kind that extends between students and a courteous and painstaking master. There was between them and Lister no fiction of equality, which tends constantly to reduce any one man's pre-eminence. And the result was that, as one of Lister's Glasgow house-surgeons wrote: "No one ever thought of absenting himself from the classroom. His words, his tone of voice and quiet dignity of bearing, accompanied in general with a serious expression, convinced all that his heart was in his work, and more than that, that our interests were his interests. His students worshipped him." Nevertheless the Glasgow authorities let him readily slip through their fingers, and the fame which brought students and graduates flocking to hear him and gave a European reputation to the medical school he served was transferred to Edinburgh.

The medical circle in Edinburgh to which Lister was going was scarcely more friendly than that which he was leaving. The *Edinburgh*

Medical Journal, which was its public voice, had spoken very little upon Lister's work. Two references alone were made to it during the years in which the method of purging polluted hospitals was being initiated in the sister city. One of these was a brief *résumé* of Mr. MacCormac's account of his work in Belfast; the other was from the pen of Dr. Joseph Bell, then assistant-surgeon to the Edinburgh Infirmary. Bell reported a number of varied cases in which he had followed Lister's method with success. But he confessed himself indifferent to the germ theory, and consequently though he had had success with carbolic, neither at this nor at a later date did he attain to a complete mastery of the antiseptic treatment.

In addition to Joseph Bell in Edinburgh, there was Thomas Keith, who as an operator had created a record that out-distanced all others by carrying out a succession of seventy abdominal operations without a death. This astounding success had been freely quoted by Lister's Glasgow opponents in order to prove how meddlesome and unnecessary the antiseptic treatment was; but they had been unexpectedly countered by Mr. Keith himself, who replied that in all these cases he had used some form of antisepsis, and was a whole-hearted believer in and follower of Lister.

Lister, of course, had a strong friend in James Syme, who though partly crippled, had not been deprived of his warrior spirit by his illness. But

the world at large was inclined to attribute Syme's support more to the partiality of a father-in-law than to an unprejudiced conviction as to the soundness of the antiseptic system, in spite of Syme's published successes and the intimate knowledge of Lister's work which he was able to gain from frequent and familiar intercourse. Nevertheless Syme was Lister's stronghold in Edinburgh, and without his powerful advocacy it is almost certain that the Edinburgh authorities would have failed to acknowledge the unique claims of Lister to the professorship. Nor indeed did they recognize them. The weight of blood or relationship in a candidacy was well recognized, and Lister's appointment was attributed by medical men far more to Syme's than to any peculiar merit of his own. "Who is that?" asked an American visitor on one occasion, impressed by Lister's appearance. "That is Mr. Lister," his friend replied. "He has been appointed a teacher in clinical surgery through Mr. Syme's influence, whose daughter he married." Wakley, it is true, through the medium of the *Lancet* urged the appointment of Lister, but the *Edinburgh Medical Journal* devoted only two lines to the subject.

The University and medical circles of Edinburgh of that time possessed many notable men. The Edinburgh scientific world was at its zenith, its fame spread wheresoever the vigour and movement of science was felt. As a medical school, without doubt Edinburgh excelled all

other medical schools in the United Kingdom. Indeed, had one gathered from the other schools the most luminous of their stars, it is doubtful if one could have rivalled the galaxy of the Scottish capital.

The two leading men were, however, at the end of their careers. James Syme, though still able to do consulting work and to enter into controversy with the old fire and pertinacity, was in the last year of his life. His greater colleague, Sir James Simpson, was dragging out the last months of his profitable life under the agonies of angina pectoris, and turning sometimes to his own beneficent chloroform for relief.

Those who were in the active practice of their profession in Edinburgh were all men of some note. There was the caustic Hughes Bennett, the Professor of Medicine, who had declared himself to be one of the rare medical philosophers who cared for the truth and had such a contempt for Pasteur's theory. There was James Spence, the Professor of Surgery—Lister being Professor of Clinical Surgery—who after Syme's retirement became the leading consulting and operating surgeon and who bore no goodwill to the founder of antisepsis. There was Sir Patrick Heron Watson, a man of great practical ability; Joseph Bell and Thomas Keith, who had already acknowledged Lister; and of the younger men, Thomas Annandale, an old friend of Lister's, a believer in his work and eventual successor to his professorship. Other notable

men were Matthews Duncan, who already had a European reputation, and succeeded Simpson in the chair of midwifery; Dr. Laycock, who, like Lister, hailed from University College, and was the only Englishman who ever occupied the chair of clinical medicine in Edinburgh; Sir Robert Christison, famous for ascending the slipperiness of Scotch mountains and medical jurisprudence; William Turner, the present Principal and the Professor of Anatomy; Douglas Maclagan, and Dr. John Brown. The Principal of the university was Sir Alexander Grant, who had succeeded Sir David Brewster in 1868. Together these doctors and professors constituted a set of men of ability and repute, who though perhaps regarding the founder of the new surgery with some curiosity, were too fully occupied with their own affairs to submit to a new career of studentship.

But also awaiting Lister at Edinburgh was a very eager and important section of medical life, namely, the students and young graduates. They anticipated Lister with no little excitement, for his fame had been bruited from their Glasgow contemporaries. With the eyes of youth, that custom had not staled, and with ears receptive to the doctrine that was likely to bring them most success in life, they were, though pupils, in reality the judges of the contest that had already begun and was now to be waged in their midst between the selected chiefs whom they served. To which camp were they to belong? To the camp of the

Photo]

EDINBURGH INFIRMARY

majority and orthodox, or to the professor about whom such strange rumours emanated from Glasgow? Were they to adhere to the old chiefs or were they to flock to the standard of the new leader? A stir of battle was in the air and rendered the charged atmosphere of student times more strained and excitatory than at any other time in medical history.

"From the beginning I had youth on my side," said Lister in later years. His success with the students and young graduates of Edinburgh was phenomenal. It began with the first lecture that he was called upon to deliver. The lecture was given in the old chemistry classroom. Sir Alexander Grant was in the chair, and many notable men were present, most of them sceptical, all curious, and some, one thinks, feeling a little dread, for the possibility of being forced to change one's faith and habit fundamentally is rarely an agreeable one. Above all, there were the younger men, who filled the room to overflowing. Old James Syme entered, and the tension of the meeting, which was already great, broke out into a stormy ovation as the familiar figure of the beloved teacher appeared once more in the midst of his students.

Lister was then forty-two years of age. His appearance at once impressed those who saw him for the first time with the feeling that they were in the presence of a great man. He was a little above the medium height, was slender and excellently proportioned. He carried him-

self with a singular grace, and every movement was fraught with the ease and control that are the qualities of dignity. His face was one that, without disparagement to his manhood, could be called beautiful. It had the high thoughtfulness, the unlined nobility, the evident detachment from momentary matters and absorption in matters that are rooted in the eternal truth, which gave to Lister's more, I think, than to any other English face the wonderful meditative serenity and power that forms the exalted aim of Oriental wisdom. His hair was dark and luxuriant, his complexion one of such clarity as indicated a blood of the purest quality and one untainted by the confused thought and incertitude which with the great mass of men connect their imperfect humours with the lined and anxious expression of their faces and the vexed light within their eyes.

Lister was an admirable teacher, his language clothing his thought with luminous simplicity. His voice was not loud, but carried easily to the limits of a lecture-hall. The words he desired came to him readily, and he never had to hesitate for the expression that was most fitting. He had a slight difficulty in pronouncing certain consonants, which, without impairing the audibility of his words, gave them a certain distinguishing personality and had a charm for his hearers, perhaps in that it robbed them of any provocative assertion which might easily have attached itself to so transcendent a message. He

was, as a fact, both as teacher and preacher of a new doctrine, absolutely free from self-assertion and affectation, and his full but gentle voice, with its slight hesitation, seemed singularly in keeping with his impressive but retiring manner. However much his doctrine aroused animosity, in his personal presence none were ever able to maintain hostility and usually passed under the spell by which he swiftly won the sympathy of others. He always spoke earnestly and gravely. He was free from solemnity and—perhaps some will think this a defect—he was also free from humour. But there was something about his mission and his gospel that I cannot but think would have accorded ill with humour. His gentle gravity and earnestness were more fitting to a message that announced the salvation from pain and death of countless human sufferers, and which required neither the excuse nor adornment of humour.

On the occasion of this opening lecture at Edinburgh, Lister was graver and more earnest than his wont. He showed a heightened colour, and his curious difficulty with certain consonants was more pronounced than usual. But from first to last his delivery was easy, his mastery of his subject absolute. He spoke extempore, and only referred to his notes when the exact nature or the figures of his results had to be recorded.

Lister began his lecture with a personal tribute to James Syme, whom he named as a teacher without rival and whom he gracefully assured

the students they would not wholly lose, for " as I have the privilege of free access to his inexhaustible store of wisdom and experience, he will, in some sense, through me be still your teacher."

He then entered into his peculiar field, in which he claimed the character of surgery had changed. " Surgery becomes something totally different from what it used to be ; and injuries and diseases formerly regarded as most formidable, or even hopeless, advance quietly and surely to recovery. Of this system the germ theory of putrefaction is the pole-star which will guide you to safety through what otherwise would be a navigation of hopeless difficulty."

Lister continued with the history of the germ theory, and spoke of work of which during the period of his earlier experiments he had been ignorant but to which his attention had since been drawn. He spoke of Cagniard-Latour and Schwann, the truth of whose researches had been popularly obliterated by the combined weight of Leibnitz and Helmholtz. " It is true," he said of Schwann's experiments, " that if you attempt to repeat the experiments you may meet with failure. But it must be remembered that merely negative results go for nothing here if the positive evidence rests on satisfactory authority. . . . If we consider what the germ theory assumes, how minute the putrefaction particles are supposed to be, and how universally present in the atmosphere and in the dust which adheres to all objects exposed to it, it is easy to under-

stand failure in such experiments consistently with the truth of the theory. But it is impossible to understand success in any single instance consistently with the falsehood of the theory." For instance, Schwann had kept meat-juice in flasks, which had first been heated, and had allowed air to enter the flasks only after it had been passed through the flame. The meat-juice remained pure indefinitely. This was a positive result effected by a great scientific authority. Meat-juice exposed to the ordinary air invariably goes bad. But by flaming the air all living germs were burnt. One genuine experiment out of a thousand failures, said Lister, was enough to prove that it was not the oxygen which caused putrefaction, but something which the heat destroyed.

Lister went on to describe the process of fermentation of beer which is analogous to the process of putrefaction. In the fermentation of beer the growing and budding yeast may readily be seen. "You can see with the microscope the torula of fermenting must or beer. Is there, you may ask, any organism to be detected in putrefying pus? Yes, gentlemen, there is. If any drop of the putrid matter is examined with a good glass, it is found to be teeming with myriads of minute bodies."

Were these tiny creatures spontaneously created in the fluid, or had they parents? Lister related his earliest experience with the vexed question, which Pasteur finally settled. As

a boy an elderly friend had informed him that cheese mites were spontaneously generated in cheese. With his microscope Lister had examined the cheese and found the eggs of the mite. From that time his doubt of the doctrine of spontaneous generation had begun.

Lister had from the first freely and continuously acknowledged his indebtedness to Pasteur. He now gave an account of the experiments of the great Frenchman, which have already been described in Chapter IV, Pasteur's "beautiful researches," as Lister called them. One of these experiments, one that "charms us alike by its simplicity and perfect conclusiveness," Lister had repeated, and now showed the results of it to his audience.

He had taken four flasks and filled each one a third full with putrescible fluid. He had then heated the necks of three of the flasks and drawn them out into long, low-dipping tubes, forming the simple type of flasks originally used by Pasteur. He had boiled the fluid in all four flasks for five minutes to kill the germs. He had then set aside the flasks with the mouths of their necks open to the air. In the fourth flask the fluid became thick and foul. The fluid in the other three flasks, on the other hand, had remained quite sweet for a space of two years, and was still sweet and clear when Lister showed two of the flasks to his audience.

What was the explanation? Air had entered and could enter freely into the flasks, for the

mouths of all of them were unstopped. But in the case of the flasks with the bent necks the air had had to pass up the long-drawn necks, and in passing up its dust by its own weight had become deposited in the neck before reaching the fluid. In the fourth flask the dust of the air had fallen unhindered into the fluid.

Lister told his audience that a few days before he had broken the neck of one of the three untainted flasks and had examined the fluid in it with the microscope. He had been unable to detect any signs of germs or organisms. He had then set aside some of the fluid that had remained pure for two years, placing it in an uncovered watch-glass. In two days its colour had become darker, it had swarmed with minute life, and had begun to smell. In a word, it had begun to putrefy.

Such experiments were convincing enough. They pointed unmistakably to the dust of the atmosphere, that coats all things, as the cause of putrefaction and to the germs, which formed the living part of the dust, as the special cause. Lister, did not, however, state this obvious deduction in so many words. He left it to the thought and judgment of his hearers, knowing full well that if they themselves contributed it the force of his facts would be more deeply implanted in their minds than if he did the whole work for them. "Gentlemen, I commend these facts to your candid and impartial judgment," were the concluding words he addressed to the

students, "beseeching you to form your own opinions regarding them. The minds which you bring to bear upon this subject to-day are very much the same as they will be throughout your lives. . . . You are as competent as you ever will be to draw logical inferences from established data. Do not, then, let any authority shake your confidence in knowledge so obtained."

It will be noticed as singular that in this first and most important lecture Lister made no reference to his surgical successes. Philosophically he desired first to implant first principles and then to establish results. If once the theory was firmly grasped by the students, he would be content, knowing full well that his words would soon be fulfilled by practical successes. In these early days at Edinburgh he was peculiarly insistent upon the truth of the germ theory.

He had a particular reason for being so. Next to Syme and Simpson, the most prominent figure in the Edinburgh medical faculty was Dr. Hughes Bennett, the Professor of Medicine. Bennett was an acute, caustic man, with a considerable gift of critical scepticism, which made him more feared than loved by his colleagues. He had been a militant advocate of the microscope, and considered the neglect of its use to be a signal proof of the imbecility of his professional brethren. The microscope was consequently in more or less general use when Lister came to Edinburgh; and Bennett had come to

regard himself as a censor of the results which others obtained by means of his favourite instrument.

Bennett's experience in things microscopic was therefore unquestioned, and the new theory that microbes and the spores of fungi existed in the dust of the air met at once with his censorship. He collected the evidence of varied observers, who had not observed the microbes in dust, though they had endeavoured to do so. "Where are the germs, then?" cried Dr. Bennett. "Show them to us and we will believe. Has anybody seen these germs? Had they any existence except in the imagination?" And again: "The dust has been ransacked for these organic germs—collected and carefully examined with the microscope, near the soil, and on the summits of the highest buildings, not only in frequented but in desert places; in crowded assemblies as well as in empty Gothic cathedrals and ancient vaults—in the ancient palace of Karnak, on the banks of the Nile; in the tomb of Rameses II at the extremity of the desert, as well as in the central chambers of the great pyramid of Gizeh." Nevertheless, nowhere could the zealous microscopist detect germs, or, Dr. Bennett admitted, "if a few, in the opinion of some, were visible," could these in any way account for the multitude found in putrefying fluids?

Disbelieving that the scattered germs in the dust could multiply to such numbers when they

had access to putrescible matter, Dr. Bennett set out to show the absurdity of the whole germ theory.

It is an axiom of science that the experiment of one observer can be repeated by another, an axiom which by leaving out the personal element occasionally leads to the queerest results. The performer by this axiom is clearly of no importance; it is the method alone that matters. Yet in very delicate scientific operations and experiments, as in the refinements of artistic work, it is the peculiar excellence of the experimenter that tells, and it is the one thing that cannot be exactly repeated by another experimenter. Where a method is coarse or where it can be so stereotyped that an average man may be trained into an exact imitation of the original worker, there the repetition of the experiment and its results may be assured. But where the experiment requires a rare and refined skill, there repetition is far less likely to succeed. This axiom of science, then, requires that scientific knowledge or work be kept, if I may use a term from high jumping, below the six-foot bar. The highest refinements of human technique or thought do not come within the scope of science, since they are personal and not repetitive.

Pasteur's experiments, being scientific, were theoretically below the six-foot bar. Dr. Bennett was a well-trained man—in fact, for experience in experimenting there was scarcely a better trained man in Scotland. He was certainly up

to any jump below the six-foot bar. But the rare and unsurpassed accuracy, the refined self-criticism, and lucid deduction of Pasteur were not his. Dr. Bennett consequently succeeded in repeating Pasteur's experiments but not his results. Nor did he stand alone in this. In France expert scientists, such as MM. Jolly and Musset, had also repeated Pasteur's experiments, but not his results. Both they and Dr. Bennett, therefore, measuring Pasteur upon the scale of themselves, concluded that the French savant was wrong. The germ theory was fallacious. The germs were "imaginary." Sir James Simpson, hearing of Dr. Bennett's work, christened them with the happy term of "mythical fungi."

It was not unnatural, therefore, that Lister felt the importance of insisting upon the truth of the germ theory to the students, amongst whom the name of Dr. Bennett was one of unequalled authority.

Before coming to Edinburgh Lister had repeated one of Pasteur's simplest experiments, and had shown the results at his first lecture. He now felt the necessity of planting himself more firmly upon the germ theory than was attained by a highly justifiable personal belief in Pasteur. He had to prove its truth to himself and to others by his own experiments. Lister was a man of indefatigable industry when he had a purpose in view. In spite of his operative and overseeing work in the hospital, in spite of the

work connected with his private practice, in spite of his classes and the time absorbed by reading the up-to-date surgical and medical literature, Lister, chiefly by early rising and putting in one or two hours of work before breakfast, managed to devote an enormous amount of labour to strengthening the foundations of the antiseptic treatment. His notes display his zeal. They most of them record observations taken between 7 a.m. and 10 a.m., but others are timed at midnight, others, again, in the raw hours of the morning between 3 and 4 a.m.

One of Lister's experiments was delightfully simple and convincing, and contains within it the principles of the best modern dairying. Lister took some wineglasses and heated them by means of a spirit-lamp. He also heated some cover-glasses for them. The covered wineglasses he took to a dairy. Under his instructions a milkman purified his hands in a solution of carbolic acid. The teats and udder of the cow were similarly purified. The cow was then milked into the wineglasses and the glasses quickly covered, taken home, and set aside. Eighteen months later Lister took the glasses to a meeting of the Royal Society of Edinburgh. In the presence of the members he uncovered a glass and sipped the aged milk. It was still sweet and pure. He handed it to Tait, the Professor of Physics. Tait also tasted it and agreed to its quality. Other glasses were uncovered and handed to the learned fellows to taste.

One after another drank at the tiny wells of truth and wondered.

It is improbable, however, that any of them made Lister's further important deduction.

Milk when exposed to the air, of course, turns sour, and mucus when exposed also goes bad. But the milk and mucus that lie in the ducts which conduct the milk from the cow's udder to the outside world do not go bad. The deduction that Lister made was that the living mucous membrane of the milk-ducts somehow prevented the development of the germs of putrefaction. Lister gained thereby an added conception of " vitality " in action, the vitality whose paralysis by irritants had formed the earliest of his particular views of Nature unveiled. The point shows how keen was his vision for all evidence bearing upon the quality of vitality and illuminates the direct continuity and wholeness of genius.

The apparatus which Pasteur had used in his experiments had been singularly simple. The fluid he had used was one calculated to test the nature of fermentation in which he was chiefly interested. It consisted of an artificially prepared solution of lump-sugar, tartrate of soda, and the ash of yeast. The fluid was rendered germ free by boiling.

Lister, on the other hand, was concerned with the question of the putrefaction of the fluids and juices of the body. He worked, therefore, chiefly with milk and fluid from the bladder. His

methods also were extremely simple. He used covered wineglasses and a glass pipette.

As a contrast to the simple methods of these two men of genius, one may take the work of a man of talent and training such as Dr. Bennett. His apparatus and method displayed the complications and cumbersomeness that debar a man from solving profound problems when he lacks the selective simplicity of genius. Dr. Bennett made use of various boiled and prepared fluids, a ball-bellows, a U-tube containing potash, a hollow glass sphere containing gun-cotton, a Liebig's tube filled with pumice-stone, a bent tube containing pumice-stone soaked in sulphuric acid, a large basin, and, lastly, the flask containing the original fluid to be tested, fittingly placed upside down.

Such an apparatus introduced a number of modifying factors and an equal number of sources of contamination. One is scarcely surprised, then, that Dr. Bennett, aiming at results by such mazy means, found so much diversity of issue that he rapidly acquired the character of a sceptic. The fluids he tested, though originally free from germs and spores, as a rule soon became a microscopical menagerie of yeasts, spores, fungi, bacteria, and vibrios, budding, elongating, sprouting, dividing, wriggling, diving, quivering with Bruonian motion, which so confused the learned professor that he could come to no other conclusion than that they had all arisen *de novo,* and that one form gave rise

to another, granules to ovules, ovules to rods, rods to filaments, and so on. What other explanation could there be, seeing that he had taken every precaution to keep his apparatus free from accidental contamination? That complexity and redundancy are the signs of lesser gifts, to which it is seldom or never granted to unravel the secrets of Nature, could scarcely appeal to him as an explanation.

Lister, on his part, caused animal fluids, either of the bladder or udder, to be passed cleanly into glasses which had been rendered germ-free, or, in technical language, sterilized by heat, and which were immediately covered by cover-glasses similarly sterilized. Under these conditions Lister found that the fluids remained pure for an indefinite period. He also found that the white of an egg, taken from an egg the shell of which had been carefully cleansed and dropped into water that had been boiled, also made an animal fluid that remained pure indefinitely in a sterilized covered glass. Thus at one stroke Lister answered those objectors who said that the boiling of the fluids or heating of the air so altered matters that the proper conditions for spontaneous generation were upset. He proved convincingly that animal fluids, even outside the body, had no inherent tendency to putrefy, and therefore that putrefaction was due to something in the air and in the dust, or to matter adherent to the sides of the glass, which the heat destroyed. Further, since the distinction between

putrefying and non-putrefying fluids lay chiefly in the fact that the first swarmed with microscopic life and the second was free, the deduction that what the heat destroyed was the microscopic life was a fair and even obvious one.

The experiments which Lister conducted not only displayed his selective simplicity—they also showed his pertinacity. For no less than two years he watched the life history of a single fungus, which he named the *Torula ovalis*, both in animal fluids and in Pasteur's solution. He saw what it did, what shapes it took, how it flourished, how it waned, and yet how through all these changes from youth to age, from starvation to fattening diets, it retained, as a human being retains, its peculiar character. This, as he himself said, was "a fact fraught with the deepest instruction." It went to show the specific character of even the minutest form of life, a character contradicting the generally held belief that, as Dr. Bennett saw, low forms of life pass readily the one into the other. Life, Lister saw, was something definite even in these low forms. The less definite vision of Dr. Bennett and many others saw microscopic life as one might watch from a balloon a street scene of moving men, women, children, dogs, horses, and traffic, unable in the medley to distinguish the specific character of each moving thing.

Lister confirmed these observations upon another organism—which he named *Oidium toruloides*—which he kept in a most ingenious

contrivance of his own that he named a " glass garden." These gardens rendered excellent results in his hands, but, like Pasteur's flasks on the Mer de Glâce, " require considerable delicacy and quickness of manipulation." " With them," he said, " I have watched one of the same organism continuing to grow unmixed in such a garden for several weeks together, though carried about with me on a journey made in an autumn holiday."

Lister proved the specific character of fungi, a proof which in medical language has now passed into the term " specific organism." In animal fluids, by a simplicity and skill equal to Pasteur's own, he confirmed the French savant's theory and did away once and for all with the oxygen theory of putrefaction.

He pointed out also the many errors into which observers could fall, and gently declared that " without the slightest doubt being thrown upon the good faith of the observers, the so-called facts are justly received with the gravest suspicion." Indeed, in some work he himself did upon the *bacterium lactis,* the common microbe of sour milk, he himself unsuspectingly fell into error owing to his fluids becoming contaminated, and drew deductions which later he had to withdraw, saying that " next to the promulgation of new truth, the best thing, I conceive, that a man can do is the recantation of public error."

On the positive side Lister made other dis-

coveries, which later became of first-rate importance in the unravelling of the mystery of disease. He indicated why it was that disease organisms were sometimes more virulent than at other times and the lines of further research, elucidating "points of great importance in the history of contagious diseases, such as the greater virulence of such disorders at some periods than others." He showed how putrefaction and blood-poisoning could occur, although the tissues of the wound had no odour, "a fact I have long suspected, as a result of antiseptic surgery," and one of primary importance in the elucidation of certain mysterious cases. He also showed that "various as are the organisms which float in the atmosphere, they constitute a very small proportion of the abounding particles of dust which a beam of sunlight reveals in an occupied chamber," and that "organic germs are not nearly so abundant in the atmosphere as is sometimes assumed," facts which eventually led to the discovery that the infection of wounds from the air, though it occurs, is quite unimportant compared to the infection from the hands and instruments of the surgeon, dresser, or nurse, or from the skin of the patient. Such were the important principles and discoveries that Lister gathered from his experiments. The small glass garden was fertile as none other before or after it with a crop of human benefit.

Lister, while at Edinburgh, carried out a good deal more bacteriological work, the greater part

of which he never published, but to which he occasionally referred in his lectures. By it he tested any new antiseptic method or dressing he thought to employ ; he strengthened his knowledge of the ways of infection, he foretold the true nature of erysipelas, he prophesied that of lockjaw, and generally cast his mind into the future with a brilliancy that, though the science of bacteriology was only in its infancy, showed such an insight that one may say there is no principle of importance in the expanded science which Lister did not gather from his experiments, conducted in the early morning hours when most men slept in bed.

A man of such energy and devotion as Lister was was bound to affect many enthusiastic youths to whom zeal is contagious. But when the same energy and devotion are combined with wonderful practical results even sluggish youths are stirred to note. Lister's successes in the usual operations continued, and, armed with the assurance of antisepsis, he devised, dared, and executed many new operations. His work in the field of operative surgery was as original and successful as elsewhere, and quite a number of new treatments were established by him at this time. With such a generating power of genius in their midst, it is not astonishing that the students took fire. An able series of students and graduates served Lister in the capacities of house-surgeon and dresser, for he acted as a magnet to all the most capable youths, and

like a magnet imparted some of his quality to them.

His lectures and clinical classes were crowded. Three to four hundred students would throng to a lecture. Such, indeed, was the enthusiasm that when the University classes broke up at midday the students would race to the infirmary in order to get seats at Lister's lecture. They knew that they would hear something original and valuable, something not in any of their textbooks, and they listened eagerly; for Lister, with his immediate vision of nature and disease, taught as one with authority. There were, however, some students who, serving other surgeons, felt called upon to oppose him and his followers, but it is stated authoritatively that when such a student fell ill and needed an operation it was to Lister and not to the other surgeons that he applied. "Those crowded hours of glorious work in Edinburgh," as one of Lister's house-surgeons called them, were days of ever-growing efficiency and success. James Syme, whilst yet able, took his own pride in it, and sometimes accompanied his son-in-law upon his hospital rounds. On one occasion Lister showed him a compound dislocation and fracture of the ankle-joint healing quietly under the new treatment. Syme turned to the patient. "You are fortunate, my man," said he. "I lost several such cases as yours in this very ward." On another occasion an elderly man who had had his foot amputated by the father-in-law returned to have another amputa-

tion higher up the limb performed upon him by the son-in-law. In a few days the man was so well that he was sitting up reading a newspaper. The house-surgeon asked him how he felt. "Oh, fine!" he replied; then, looking round the clean and healthy ward, he added, "Eh, man, but you have made grand improvements since I was last here." Lister, on being told the story, was greatly pleased, and said to the patient in the course of his visit, "So you think we have made great improvements since you were last here?" The man replied heartily in the affirmative. Lister smiled the "rare, sweet smile" that sometimes broke upon his accustomed gravity, but made no comment.

In addition to winning over the students, Lister began to gain the adherence of many foreign medical men, who came to visit Edinburgh either owing to the University's general repute or expressly to see Lister's work. Professor Saxtorph, whose powerful evidence of the cleansing of Frederik's Hospital, in Copenhagen, has been recorded, was an annual visitor. Dr. Lucas Champonnière, as a medical student, had visited Lister in Glasgow and continued to follow his work with great care. German and Danish surgeons in especial came to study Lister's methods, and to compare what they saw in the wards of his colleagues at the infirmary. Again and again Lister entered into an explanation of his principles and the minutiæ of his dressings, speaking in French or German

if there was need. He then showed his visitors his results.

Lister, his wife, and frequently her sister, Syme's younger daughter, lived in Charlotte Square, the square inhabited by the leading professional men of Edinburgh. They lived very quietly, rarely going out into society and devoting their time to the furtherance of the antiseptic system. Here Lister entertained his visitors, showed them laboratory experiments, hospital records, and everything that would help them to comprehend his method.

But "his own countrymen," wrote Dr. Grasset, one of his house-surgeons, "and those on the staff of his own hospital were infrequent visitors." Two surgeons to the infirmary were, however, thorough believers in antiseptic surgery—namely, Mr. Annandale and Mr. Joseph Bell—and practised it with success, though not with the success of Lister, finding the new principles difficult to grasp in their entirety. A younger man, John Chiene, the present Professor of Surgery at Edinburgh, was a wholehearted disciple, and so mastered the method that, on his being elected assistant-surgeon, Lister gave him a large share of the practical work in his wards, and when he himself was away left him in charge without any fear that the patients would suffer by his absence.

The neglect on the part of his colleagues and countrymen hurt Lister, and caused him to feel very sad at the thought of the great suffering

that might be allayed. And, strangely enough, this neglect led to one of the very few good stories that are attached to this man who in public preserved so grave a demeanour. He had occasion to operate upon a woman for cancer. Under strict antisepsis the wound healed painlessly and progressively. In showing it to his class, Lister thought with a sigh of the many sufferers who were kept from the bounty his patient had enjoyed, and said, "What would not be said of antisepsis if only this woman had been a princess of the realm!" An enterprising American surgeon who was listening was ready with a singular reply. "Say, Mr. Lister," he said, "what a pity it is you do not practise surgery in America, where every patient is a king or a queen!" Lister looked with some surprise at his interlocutor, but preserved silence.

Shortly after this Lister was called to operate upon a lady of less romantic royalty. Queen Victoria was suffering from a painful abscess, and Lister was summoned to Balmoral by her Majesty's physician, Sir William Jenner. Lister found the Queen more ill than he expected and Sir William seriously anxious, though he had not made his anxiety public. The abscess beneath the arm was a large one. Lister prepared to open it with his usual precautions, also making use of a carbolic spray apparatus worked by hand, the nature of which will be described in Chapter XIII, where Lister's full technique will be given. The skin over the abscess was first

frozen with ether to allay the pain. During the brief operation a slight spray of carbolic, passing the shoulder, touched the Queen's face. She complained to Sir William Jenner. "Madam," he replied, in humorous excuse, "I am only the man who works the bellows." The Queen looked at Lister's grave face and smilingly asserted that she liked the smell of carbolic, and Lister was by her gentle tact enabled to proceed.

The operation was successful. Lister put in a strip of carbolic lint to keep the wound open for drainage. But, unfortunately, the matter of the abscess did not come away properly, and the Queen was still feverish and in pain. Lister, disturbed by this unfavourable course, walked alone in the grounds of Balmoral, a lonely walk being his custom when he had a difficult problem to solve. During his cogitations it occurred to him that a piece of indiarubber tubing might form an excellent path of exit to the discharge of a wound. It is illustrative of Lister's bold faith in himself that, though his patient was the highest lady in the land, he did not hesitate to make her the first subject of this experiment. It is true that the French surgeon M. Chassaignac had already made use of tubes of decalcified bone for a like purpose, but it seems that Lister had not then heard of the Frenchman's work. Lister returned from his walk, cut a piece of tubing from the spray apparatus, and soaked it all night in carbolic. In the morning he

made use of it, and at the next dressing, to his "inexpressible joy," the discharge was thin and watery. The Queen made a rapid and complete recovery. Lister, confirmed by his royal experiment, adopted rubber drainage-tubes as a part of his practice.

CHAPTER X

TOO LATE

THE crisis of ill-directed and ill-managed charity, if indeed such shameful misdirection can couple its infamy with the kindlier word, was reached in English records in the military hospitals at Scutari in 1854, the first winter of the Crimean War. There more convincingly than anywhere else it was shown how man, directing his efforts of benefit according to the dictates of civilization, could nevertheless make for himself a harbourage of pestilence and death. The terrible tale has often been told, and I need only briefly dwell upon it in its less known surgical aspects in order to show how, in times that elder folk can still recall, the tragedy of incompetence stamped itself upon a people who are not yet free from the qualities that gave rise to it.

The story is inseparably connected with the single efficient person concerned in it, the gentle and commanding lady who cleansed the hospitals from their grosser impurities. For not only were pyæmia, hospital gangrene, and all the horrible forms of blood-poisoning rife amongst the wounded and as sequels to ampu-

tations, but other foul diseases, such as scurvy, typhus, and dysentery, with which Miss Nightingale was more able to cope, also made these hospitals fœtid places of corruption. "In Kululi," she wrote in her report to the so-called Government, "the worst of all the hospitals, during February, one out of every two cases treated died, and in Scutari and Kululi together two out of every five, in the same month." With each fresh batch of wounded and sick from the front "a frightful increase of mortality occurred immediately, or two or three days afterwards, as far as could be ascertained, among the admissions, who stand such sanitary conditions less well than those inured to them." "The foul air was almost certain death to them; and accordingly they died, in the month of February, at the rate of 415 per cent. per annum. So that in twelve months, at such a rate, the whole sick population of the hospitals would have perished four times." The hospitals destroyed the army far faster than the home authorities could recruit it.

Such figures and statements, appalling though they are, appeal to the mind rather than the senses. It is by the senses that one is able to realize the abiding horror of such nests of pestilence. "The stench is appalling," wrote William Russell. Others described the rats as they ran from one piece of diseased and disjoined flesh to another, or even fed upon the mutilated limbs of the miserable sufferers. The picture is so

horrible, it would rightly be buried in oblivion were it not necessary perpetually to remind a people of the supreme need of genius in the direction of affairs at moments when fate demands some prodigious effort, or when, under the security of peace, the good intentions of ordinary men have become the motives of policy, with the resulting inevitable confusion of meddlesome mediocrity.

With these pictures of the Crimean War before them, one would have thought that all European lands would have given the question of military medical management earnest attention. Above all one would have expected France, our ally in the Crimea and sufferer from incompetence to an even greater extent than ourselves, to have been most careful to promote efficiency. But France was proudly in the van of the experiments in government with which modern Europe has been so busy. Infused by democratic principles, she had destroyed any continuity of responsibility. There was, therefore, no family or class whose duty it was to remember and store up the lesson of the Crimea. The lesson fell unheeded, and in the Franco-German War the terrible harvest of disaster, France's just reward in this life of retributive justice, was reaped.

Prussia, profiting by some bad experience in the Austrian War of 1866, and guided by the ascendant genius of Bismarck, fell into no such errors. All the most capable men were given peculiar authority coupled with personal respon-

sibility. In the medical department as in the other departments the Prussians went into the war with the knowledge of efficiency. "Our sanitary organization," wrote a Prussian authority on the eve of the outbreak, "may now compete with the best in the world." For field-service the training of officers and men was remarkably efficient. To avoid the evils of overcrowded hospitals or the paralysis of centralization, a large medical division was trained to break up into smaller and independent components. It was thus able to form a number of small hospital staffs, each one of which was able to care for so many sick and wounded and to save those under their charge from the fearful dangers that attach to a large, unwieldy collection of the unhealthy. In addition to these divisible staffs, twelve light hospitals were provided for every 30,000 combatants. Each soldier also carried as a part of his kit a tin of dressings, the tin bearing the number of the soldier so that he could at once be identified and placed. So many men in each regiment were also already trained in the elements of military surgery, lest at any time the numbers of the regular staff should be deficient. One soldier in every eight was prepared, if called upon, to carry out emergency duties. All likely to be concerned with the wounded were instructed in the safety of the open air and the danger of crowded rooms. There was a large supply of medical wagons with surgical instruments, dressings, and stretchers for

following each regiment. The Army Medical Service was given the first choice of any building or water supply in town or village. Nothing that might bring about a disciplined efficiency was left undone. The chief of all this medical organization himself bore the appropriate name of Dr. Grimm. No wonder that the army doctors said, "So may the war begin: we are prepared to vanquish some of its terrors." The knowledge, however, of Listerism came to the Germans too late for use in this grand organization, and much human suffering that might have been allayed resulted.

Nevertheless the Germans were right in their confidence and amply rewarded for their efficiency. All the earlier medical reports of the war showed how skilfully the Germans staved off the crippling disaster of disease. Much as the world marvelled at the rapidity and exactitude of the movements of the troops, military surgeons of other nations marvelled yet more at the ability of the medical department in keeping such vast numbers of men comparatively free from disease. The soldiers were picked men, it is true, the authorities sending no raw and ill-disciplined striplings to the front as did the French. The soldiers were instructed in the rules of health and slept out in the open freely to avoid the contagion of infected houses. Later, when they came into close contact with the French at Metz and Sedan, the French revenged themselves upon their conquerors in some small degree by

spreading amongst them the diseases bred of mismanagement. But on the whole the confidence of the Germans in their efficiency was justified.

Though they were able to defend themselves with considerable success against typhus, dysentery, and other military epidemics, they were not able to free the wounded from the perils of pyæmia and blood-poisoning. Here, also, their record was not so terrible as those of the past. The keeping of patients in the open air, and in buildings the ample ventilation and avoidance of overcrowding were beneficial, but not sufficient. The great weapon of defence, Lister's antisepsis, was wanting. Some surgeons had heard of the work that had been done in Scotland, but the great majority were as yet ignorant. Shortly after the war, with the horrors of the war still haunting them, they became devoted and enthusiastic followers of Listerism. But the saving of life and limb they could then have effected was unfortunately missed by a brief interlude of time.

Many of them, however, knew something of the power of carbolic acid. Many surgeons syringed out wounds with solutions of the acid or Condy's Fluid, and with experience they came to trust carbolic more and more.

A number of different ways of using it were employed. In addition to the syringing, the principal method was to soak charpie, composed of strips of lint, in a solution of carbolic and to lay it upon the wound. But no precautions

were taken to prevent the volatilization of the carbolic, which was one of Lister's essential principles. Superficial wounds did well, but deeper wounds led to the tragedies of pyæmia, ulceration of the arteries with sudden outbursts of blood and all the horrors that await upon decomposition. "As for dressing exactly according to Mr. Lister's plan," said one witness well versed in Lister's methods, "I saw none of it anywhere."

The record, then, of the more serious wounds and operations was the old record of failure. There is no need to draw again the sinister picture the German surgical hospitals presented. A few figures and facts will suffice. Amputations gave particularly evil results. Stromeyer is said to have amputated thirty-six times through the knee-joint, until death in each case impelled him to desist. Von Nussbaum, who later was to be Lister's chief German disciple, had almost similar results, losing a succession of thirty-four. Such a fell mortality negatived completely the mercy of the surgeon's knife and gave it a place beside the unerring edge of the guillotine. "In the lower limb," a report ran, "scarcely an amputation recovered, death resulting from exhaustion and sloughing of the flaps, and frequently from pyæmia." "Pyæmia raged here as elsewhere," was the tale of another report. Hospitals were "hotbeds of pyæmia . . . in spite of the most perfect arrangements." A freshly erected or organized hospital kept free from blood-poison-

ing for a few weeks, and then the diseases of decomposition began with increasing frequency and virulence to seize upon their victims. Only the worst form, that of hospital gangrene, for some unknown reason was comparatively rare.

The French surgeons on their part had had the advantage of experience in the Crimean War and in the Italian campaign of 1859. They, moreover, possessed Pasteur for their countryman, whose name by that date was famous amongst all Frenchmen who followed science. Theirs also was the country in which the first Napoleon had organized his marvellous armies and had given to the medical departments such a share of the extraordinary efficiency that radiated from him as comported with the objects of war.

But the French had interrupted the tradition of Napoleon and mingled it with memories of feebleness. Their experiences in the Crimea and Italy had appalled them, but had not produced any man of mastery. They had no man like Bismarck to imbue everything with power and capacity.

As a consequence, in spite of their recent experience, in spite of their goodwill, in spite of all things that should, were it possible, make commonplace men men of mastery, the French military system, and with it the medical system, like a child's tower built of cards, fell to pieces under the first pressure that was put upon them. From all sides came reports of

the same dolorous tale of helpless inefficiency. Utter disorganization followed the first check. Like the tissues of the frog's web which Lister saw paralysed by injury, so a paralysis seized the French after the initial injuries. They had as a nation destroyed those born to high places and to the habit of responsibility and command. They had given Europe a tremendous picture of the forces of liberty. They had followed it with a yet great picture of the power of supreme genius. They were now destined to give a picture of a nation who had lost its governing caste and tradition, and were trusting to such chance leaders as liberty and the caprice of the people without definite standards may supply.

The result in the medical department was terrible. Goodwill was paralysed by ineptitude. "An absence of all administration prevailed on every side." This condition of maladministration was soon succeeded "by one of apathy and indifference." Amongst the sick and wounded the resulting suffering was horrible. "It far surpassed anything that prevailed at Scutari in the worst of times." Happy the wounded Frenchman who escaped the merciless impotence of his countrymen and endured the iron clemency of their conquerors! The tale of disaster attained its climax in the besieged capital. The wounded were crowded into the hospitals of Paris. Large buildings and private houses were filled with the overflow. And then death in all its most monstrous and horrific forms entered to

empty them and provide space for a fresh inflow of doomed men. Hospital gangrene and pyæmia raged with a virulence that surpassed all previous disasters. Whilst Listerism lay at hand, that which it was to destroy rose up and as a last effort dealt its most fearful blow to mankind. One passing along the streets of Paris recognized at a distance a surgical hospital owing to the stench of the human putridity it contained. Ninety out of every hundred men who suffered amputations are said to have succumbed, whilst ten secured a sickly tenure of crippled life. In all the French seats of the war the results of the surgeon's craft were scarcely better. The official figures of Inspector-General Dr. J. C. Chenu reported that there were 13,173 amputations of all sorts, including lesser ones such as those of fingers and toes, and of these 13,173, 10,006 died. Such was the frightful mortality of the beneficent surgical art. "Ce n'est pas sans une profonde doleur," wrote General Chenu in his Introduction, "que nous avons entrepris ce travail, qui va rappeler les malheurs de la France."

Yet Pasteur, who had enlightened Lister, was working in the École Normal in Paris until the September before the siege began. By the advice of his friends he, "a useless mouth" in the coming hunger, retired to Arbois to save himself for those labours in the silk, agricultural, and brewing industries, which led to such increased prosperity that he alone may be said

to have paid the £100,000,000 of indemnity to Germany. One wonders he did not urge the adoption of Lister's methods, but his understanding of surgery was perhaps insufficient to enable him properly to estimate the value of antisepsis.

Two prominent Parisian surgeons, Drs. Alphonse Guérin and Maisonneuve, had both been counted by Sir James Simpson as Lister's predecessors. Both had for some time made use of carbolic acid, but there their resemblance to Lister ceased. Dr. Maisonneuve had had better success than most surgeons, and enjoyed the repute of being the leading man in his profession. Yet in the Hôtel Dieu, where he worked, every case of amputation through the thigh ended in death. In all the Parisian hospitals during the war it was the same tragic tale. Even in the wooden-huts hospital at Passy pyæmia and other blood-poisonings killed every patient who underwent an amputation.

Thus throughout the war, which followed three years after Lister's publication of his early successes at Glasgow, there was no member of his profession who gave its incomparable benefits to the unfortunate wounded. It was said by some in excuse that antisepsis was too complicated and required too much time and care to be employed in military field surgery. But had anyone grasped Lister's principles, nothing could have been easier than their practical application.

The dictatorship of a military period would have been peculiarly suitable for bringing about

the general adoption of Lister's principles. At times of peace a general adoption of a profitable innovation can only be made by some imperial paternal system, such as the Russian or Japanese, which have carried out vast and sudden changes without revolution or even marked commotion. The Prussian system also admitted of rapid adoption of any new method approved of by the highest authority. In short, any system in which the paternal principle existed and in which one voice could command all in a matter of benefit, a striking improvement can be quickly and effectually generalized. Otherwise only the temporary existence of a system of discipline during a war provides the means of quick and general adoption. There was as great opportunity for such a beneficial and general adoption of Lister's principles during the Franco-German War, but it was not taken.

Lister himself, upon the outbreak of the war, had published a pamphlet giving a simple means of antiseptic treatment "applicable to wounded soldiers in the present war." By this he made the general adoption of his invaluable treatment possible, and had Pasteur's countrymen made use of it it might even have turned the scales of fate in their favour. At least the destruction of the soldiers would not have been nearly so great, wounded men in many cases would have been rapidly restored to fighting capacity, and the army would have been freed from the paralysis caused by the enormous number of sick men.

The materials needed for the treatment, which Lister described in his pamphlet, were simple enough, and the mode of using them was equally simple. There were no grounds whatever for the excuse that the antiseptic treatment was too complicated for use in field work. The reader can judge as to its simplicity from the following condensation of Lister's pamphlet, which only occupied four pages of print :—

After the wound had been washed out with carbolic lotion and any bleeding arteries had been secured by antiseptic ligatures, the wound was to be covered first by a slip of oiled silk smeared with carbolic oil, then with a piece of lint or rag soaked in the oil, then a piece of thin gutta-percha tissue overlapping the lint, once more a piece of lint or rag or towel, wrung out in oil, finally a second piece of overlapping gutta-percha tissue, and the whole bandaged on to the wound. As blood soaked into this dressing, wrote Lister, the outer layer of lint, rag, or towel should be squeezed out and soaked afresh in the oil. When the discharge had ceased, damping of the outer layer with the oil every two days would be sufficient.

The lay reader will see at once how simple this dressing was, and can, perhaps, share with the medical mind an admiration of its perfection. The inner dressing did not have to be removed at all, and so the healing wound was left completely at rest and the great pain of its disturbance avoided. Only the outer layer,

separated from the wound, was touched by the dresser.

The treatment also showed a bold faith in the healing power of nature. After being protected the wound was left entirely to itself. In this, this dressing seems to me as perfect as any imaginable for a wound incurred in war. Had it been used by the military surgeons, a thousand wounds that admitted death would have been shielded, while life and vitality were renewed. But such is the way of men that it needed the experience of this war and the horrors of putrefaction in living sufferers, which they witnessed, to bring to them a conviction that came too late to wipe off from the slate of history a story of irreparable woe.

CHAPTER XI

THE FURTHER SPREAD OF THE GOOD TIDINGS

THE surgical horrors of the Franco-Prussian war, being at a distance, did not make a deep impression upon British medical men. A few British surgeons did go to the seat of the war to join with the Americans in the Anglo-American ambulance. The chief surgeon of this ambulance was Mr. William MacCormac, of Belfast, who had already expressed his adherence to Listerism, though modifying Lister's technique. But apparently he did not carry out a complete antiseptic treatment in the many operations he performed when his ambulance was at Sedan, for his dresser, Dr. Ryan, reported that there was no real antisepsis of the instruments and addenda. The results obtained, though better than elsewhere, were not in any way striking.

In 1871 Lister was given a peculiar opportunity to bring his views forward. He was chosen to deliver the address in surgery before the British Medical Association's Annual Meeting, which in that year took place at Plymouth. His repute was growing, and men were anxious to

have an opportunity of considering if he was to prove the greatest benefactor of their art or a fanatic with an ephemeral panacea.

Lister's address was one of considerable eloquence, and, indeed, it is notable that as the subject of his heart revealed itself to him in all its great power, so his language gained a ripeness and volume suitable to its exposition.

It was customary for this annual address to take the form of a general review of surgery, but Lister felt that he, at least, was not expected to follow any precedent. Men wanted to hear about his unprecedented work and proclaimed success. So he began at once with the subject of the antiseptic treatment—a treatment which " is calculated, I believe, to revolutionize every department of surgery." The fact that his name was associated with this topic, he continued, made him shrink from adopting it, but " this connection has in all probability led to my standing before you to-day."

He went on to urge his hearers to accept the germ theory as an act of faith. " Few medical men in active practice have the leisure to sift and weigh the facts and arguments of such a discussion," he said. If they would take the theory as an act of faith, then in their practice he could promise them good results. But more he could not promise, unless they could come to Edinburgh and personally study with him and witness his procedure. Disciples converted by print he found were disciples only in part. By

" mere description " he could not confirm their practice. Such was one of the great difficulties with which both he and they had to contend. Personal discipleship is always necessary to the proper adoption of a new doctrine. Come and see is alone suitable to matter of real value. Come and hear belongs to more evasive doctrine.

A detailed account of the address is needless. It contained the same insistence upon Pasteur's theory and the same demonstration of Pasteur's initial simple experiment. Lister met the critics of this experiment with some warmth. " I confess, Mr. President, I am ready to blush for the character of our profession for scientific accuracy when I see the loose comments sometimes made upon this experiment; and I am tempted to doubt whether some of the commentators can have enjoyed the advantages of sufficient education either in chemistry, physics, or logic. The simplicity and perfect conclusiveness of the experiment constitute its great charm, and render it, as it appears to me, deserving of your careful consideration."

Lister passed from the germ theory to the methods of his practice and their results, and was able to declare that his Edinburgh wards continued to preserve a freedom from blood-poisoning.

Finally he declared that, in view of these results, he was surprised at the apathy shown in many quarters to a treatment so beneficial

to suffering humanity, and concluded with the language of Macbeth :—

> " Can such things be,
> And overcome us like a summer's cloud
> Without our special wonder ? "

For some reason this address seemed to have aroused more resentment than anything else. One thinks, perhaps, it was because Lister taught as one with authority, and not in the customary manner of Association addresses. To declare that what he taught would revolutionize every branch of surgery was to suggest that surgery and its practitioners were in a bad way, and was very different to the conventional flattery which large gatherings expect.

For the next two years there was a lull of interest, and the opposition of apathy rather than attack. Indeed there was little to attack, for none could deny Lister's results at the Edinburgh Infirmary nor those of the men " scattered up and down in this country and in various parts of the world," who, " having witnessed the treatment in our wards, whether as students or qualified practitioners, are attaining exactly the same results as we do."

An opportunity of attack, not upon the results but upon the theory, arose from the experiments of Dr. Charlton Bastian, a young London physician, which, like the previous experiments of Dr. Hughes Bennett, by their varied results apparently disproved the germ theory of Pasteur.

Something had turned the *Lancet*, hitherto Lister's chief advocate in London, against him. One cannot think that as the chief London paper it felt compelled eventually to range itself with London's hostility to Lister, but whatsoever it was, its attitude assumed the form of avowed personal opposition, which collects with illogical zeal any points that seem to tell against an opponent. From this time onwards Mr. Wakley allied himself with the obstinate jealousy that London surgeons showed to the growing fame of the Edinburgh professor. In the light of his original and singular championship, I confess that I know of no explanation of the change. Nevertheless, a certain bitter tone that accompanied it seemed to preclude it being due to an impartial and unprejudiced disbelief in Pasteur's germ theory.

Thus, following upon Dr. Bastian's work, the *Lancet* in 1873 devoted a leading article decrying the germ theory. The writer did not, of course, deny the success Lister himself had had with the "now celebrated antiseptic system," but he took the curiously illogical view that the thought upon which the system was based was rotten, and hence by allusion attributed Lister's success to some providential and inexplicable chance. "Would M. Pasteur, in the present state of science, still attempt to uphold his vital theory of fermentation?" Would Professor Lister still give "an unqualified adherence to the doctrines of M. Pasteur"? But neither of

these great scientists turned from the truths of their own experiments to the contradictions of others.

The *Lancet* followed this attack with a further article, in which the writer made a deliberate attempt to belittle Lister's bacteriological work upon the grounds of its chief merit, namely, its simplicity. This curious objection seems, one thinks, to indicate personal spite in a writer, who declared that he found it " difficult to see, from the facts he has brought forward, why Professor Lister should have thought himself entitled to any definite opinion upon this part of the theory." Lister did not reply to either of these articles.

An even stranger attack occurred in the following year. Mr. Gamgee, of Birmingham and tissue fame, was a man with original views upon the treatment of wounds. Baffled by the conflicting opinions upon Lister's teaching, he offered himself as an impartial critic in order to deliver a public and, it was to be hoped, decisive judgment.

Lister, of course, did not refuse. Mr. Gamgee came to Edinburgh, and all the evidence was laid before him. In his published report he bore testimony to Lister's good results, some of which he said were " brilliantly good." But his comments upon the thought and theory that had produced these results were in no way appreciative. Mr. Gamgee could not bear to see his own idols dispossessed. Mr.

Lister, he said, most unwisely ignored " the marvellous efficacy of two such remedial principles as compression and suspension (hyponarthesis, not mere elevation), and does not at the same time weigh the relative advantages of moist and dry, of frequent and rare dressings." Neglecting these valuable principles, Mr. Lister had pinned his faith to the theory of Pasteur and adhered to it with unflinching fidelity. And this in spite of criticism, in spite of the floods of contradictory experimental results that kept pouring in from different observers! These results would infallibly crush Lister's faith in the germ theory were it not that the Edinburgh professor was possessed of an obstinacy which ignored facts as well as the great advantages of hyponarthesis. Such was Mr. Gamgee's judgment. Lister, rarely drawn into controversy, felt compelled to reply to a judgment that had been given under circumstances of peculiar state and publicity. He answered with his usual terse irony and directness.

" Mr. Gamgee in his report," he wrote in the *British Medical Journal*, " says that I have adopted on insufficient grounds a theory which ' is made to fit all difficulties, and is itself maintained immutably in the presence of a succession of very varying facts.'

" Whether or not I deserve the grave charge thus publicly alleged against my professional character it would be unbecoming for me to discuss in your columns, but I trust that some at

least among your readers will draw a broad line of distinction between the facts which Mr. Gamgee has recorded and his comments upon them."

Meanwhile personal discipleship was slowly converting medical men to Lister's doctrine. Some practitioners visited Lister, studied with him, and returning to their practices found themselves the masters of security and not the sport of chance. As "humble exponents of the views of a most able surgeon" they bore witness to their success. Among the ranks of the leading surgeons Mr. Lund, of Manchester, went to study with Lister, and urged with enthusiasm the general adoption of this wonderful treatment. In Scotland, at Glasgow, Aberdeen, and Edinburgh, the adherents of Lister were numerous. As Sir Robert Christison told the Board of the Edinburgh Infirmary, when they complained about the expense of the carbolic compared to the water dressings, the use of antiseptics, at first confined to Lister's wards, was very general throughout the infirmary. Nevertheless, even in Edinburgh the recognition of Lister was very partial, and Professor Caird, when an Edinburgh student in 1874, was told to "have nothing to do with Lister; he is hopelessly unorthodox," although his wards were pure, whereas in some others patients died "like sheep upon the hillside."

Of public men of enlightenment Professor Tyndall was a strong supporter of Pasteur's

theory and Lister's treatment. Professor Huxley, himself a qualified surgeon, personally visited Lister and leagued himself with his friend Tyndall. "What amazes me, Mr. Lister," he said on the occasion of his visit, "is the painlessness of your wounds. You have not only banished those awful scourges which used to affect our wards, but you have abolished the pain and suffering associated with wounds and surgery."

The London surgeons, however, remained obdurate, confirmed in what the Catholic theologian terms invincible ignorance. Only one whole-hearted testimony came from London in these years, and by a singular irony it heightens instead of mollifies the stubborn neglect of the London medical world. This testimony was from Dr. Lichtenberg, a German surgeon attached to the German Hospital in Tottenham.

Dr. Lichtenberg, however, came from a country which in assimilating the science of the age brooked no rival. There can be no doubt that the distinctive feature of the last half-century of European history has been the efficiency of Germany. No country has paid greater heed to the claims of intellect nor given so large a body of university scientists and doctors a freedom from financial cares that they may the more disinterestedly pursue the paths of knowledge. The medical profession, both before and after the Franco-German War, shared very largely in the general efficiency, and, with

the one exception of Professor Saxtorph, it was in Germany that the power over disease, which Lister had devised, was first generally recognized as possessing the supreme value which subsequent generations have accorded to it.

The horrors of blood-poisoning had been vividly impressed upon the surgeons who had taken part in the war. Many a dreadful sight was stamped upon their memories and returned in graphic pictures to their minds whensoever thought or conversation dwelt upon their experiences. Many of Lister's first German disciples owed their early and complete conversion to the awful seriousness with which they had come to regard pyæmia and hospital gangrene during and after the war, when sick men were many and hospitals overcrowded. Von Langenbeck, von Esmarch, von Volkmann, von Nussbaum, and many others had been convinced of the utter need of a surgery that was less closely allied to pain and death, and of the hopefulness of carbolic and other antiseptics. "We have to thank the use of carbolic for much good," wrote von Nussbaum, who more than any other man was to startle the world with the wonders of Listerism, writing from the seat of the war. A few weeks later, writing from Orleans, his praise of the carbolic dressings was much warmer. "Carbolic is a godsend. You must know that this discovery of Lister's has worked wonders. . . . Fractures due to shot are particularly suitable for Lister's method; and if you ask me how

I would recommend you to dress such fractures and evil-looking shot wounds, I would tell you with all the emphasis at my command to use the carbolic dressings and them alone."

After the war von Nussbaum returned to the Munich State Hospital, where he was chief surgeon. This hospital was at this time in a clean condition, but as more and more wounded men were brought to it, and the growing industries of Munich led to a larger poor population, it soon became permanently overcrowded. As a result the terrible hospital gangrene occurred. Von Nussbaum's use of carbolic failed before this loathsome disease. In 1872, 26 per cent. of wounded or operated patients were attacked. In 1873 the figures mounted to 50 per cent.; and in 1874 hospital gangrene, "gnawing at the wounds like a wild beast," as von Nussbaum graphically described it, slew or permanently crippled eighty out of every hundred surgical patients. This was a calamity almost without parallel, except in besieged Paris. "The cleanliness and neatness of these wards does not deceive me," said a distinguished visitor. "I deplore both you and the patients who are sent to your wards, for they are but lightly concealed graves."

Von Nussbaum, who was a man of noble character, sank into despair. He suffered unendurable mental agonies. He had tried every treatment, the open treatment of wounds by which they were left uncovered, the old forms

of dressing, and the carbolic with which he had previously had success. All was in vain. His wards were filled with the stench of foulness and the sharp cries of agony. At last a happy idea occurred to him. Why should he not appeal to Lister for help? At any rate there was none other to whom he could turn. So he dispatched one of his assistants, Dr. Lindpainter, to Edinburgh, to spend such time as would make him master of Lister's full technique and treatment. Upon Lindpainter's return von Nussbaum laid his wards under the sternest and minutest Listerian régime. The result was a complete transformation. The horrible gangrene vanished, as a mist rolls back before the sun.

In an address that became famous, delivered in April, 1875, von Nussbaum paid a glowing tribute to Lister. "Lister's Great Discovery" was its title. "Lister's treatment," he declared, "is already being greeted by the whole civilized world as an enormous advance. Everything new receives criticism, and Lister's methods have been much criticized, but such proofs can be obtained from it that one has no use for any words but those of gratitude and admiration. . . . It repays trouble a thousandfold. . . . Look now at my sick wards, recently ravaged by death. I can only say that I and my assistants and my nurses are overwhelmed with joy and undertake all the extra trouble the treatment entails with the greatest zeal. The happiest mood possesses us, whilst before we went about with hanging

heads. What wonders of conservative surgery has the future in store for us!"

Von Nussbaum made his discipleship not only eloquent but thorough. He countered the ridiculous accusation of cost that was sometimes brought against Listerism by showing the enormous economy brought about by its efficacy in restoring people to health. Chronic invalids were no longer manufactured by the hospital to be turned out upon a heavily burdened State. There was no longer the big bill for coffins. There was no longer any need to evacuate hospitals, or even to pull them down, as the only means of getting rid of infection.

Von Nussbaum went farther. With Dr. Lindpainter he produced the first statistical proof of the results of antisepsis. It was published in the *Deutsche Zeitschrift für Chirurgie* in October, 1876, and contained separate accounts of every case that had been admitted to hospital. All had been treated by Listerism, and the results were overwhelmingly in its favour.

Professor von Volkmann, of Halle, anticipated the Munich professor in the full adoption of Lister's methods. He also had the same experience upon returning from the front. Industrialism had already led to a greater demand upon the hospital, and the war made this overcrowding final. Then pyæmia and hospital gangrene arose to empty the wards that had become so overfilled. In the winter of 1872 these diseases were so ruthless that von Volk-

mann proposed to close the hospital before the destruction to which it had been condemned began. It was then, however, that he, fortunately, heard of Lister's work. He immediately procured all Lister's papers, and carefully studied and cautiously practised every detail of treatment that he found in them. Von Volkmann, indeed, seems to have been the one surgeon who succeeded in securing the full benefits of the antiseptic treatment without paying a personal visit to Edinburgh or sending one of his assistants. It is true that his friend, Dr. Schultze, visited Lister in 1873 and wrote a full description of the system for von Volkmann's "Collection of Clinical Lectures," but by that time the antiseptic system had been installed in the Halle Hospital for several months.

Not only did von Volkmann learn the antiseptic treatment from what he read, but his results were equal to those of Lister himself, and in the case of chronic abscesses even surpassed Lister's. Of seventy-five patients suffering from compound fracture all recovered without loss of limb. Of 139 patients upon whom amputation was performed only four died, and two of these soon after the operation owing to the shock of the initial accident. Yet but recently before the introduction of antisepsis the deaths from amputation had been as much as ten to twenty times as many. Of the many patients who had received the dangerous open wounds of joints not one treated by von Volkmann died.

He, moreover, dared many new kinds of operations, which previously he would have considered homicidal. The results were truly magnificent. The antiseptic treatment in his hands proved a veritable talisman of life. His results were lifted at once to a level that is rarely, if ever, attained by the best surgeons of to-day. They were secured in a small and overcrowded hospital, appropriately built over one of the largest sewers of the town. Previous to the introduction of antisepsis it had had so evil a reputation for hospitalism that it had been condemned to demolition. But von Volkmann, without any of the architectural and mechanical extravagances of the modern hospital, changed this trap of charity into a true blessing to the sick and wounded.

Before von Volkmann in actual precedence in adopting Listerism was Professor von Thiersch, who had been appointed the chief surgeon to the Leipsig Hospital. "It was one of the worst hospitals," he said. Pyæmia and hospital gangrene held their customary resistless sway. Like the two great German surgeons already mentioned, von Thiersch was a man of noble and devoted character. Horrified at the constant spectacle of agony and death, he had, by continuous agitation, prevailed upon the authorities to abandon the building in which he worked, with all its furniture and fittings, and to erect and equip another. For a time all went well in the new building, and then one day an un-

happy patient was seized with the dread gangrene. Appalled by the resistless cruelty that pursued his patients, von Thiersch, instead of sinking into apathy at what he could not prevent, searched energetically everywhere for help. He read the first papers Lister published in 1867, and forthwith adopted the new treatment. Later, however, he substituted salicylic acid for carbolic, as being less caustic and less volatile. Our results, he said in 1875, "are not so good, it is true, as those of Lister himself, or of von Volkmann," but the terrors of the past had been totally abolished. He also published an account of 160 cases, with full details of treatment, results and cost, and the characteristic German thoroughness.

In Berlin Professor von Bardeleben, who paid a personal visit to Lister, had changed the character of his wards. The veteran von Langenbeck, Germany's most distinguished surgeon, had allowed neither his years nor his fame to hinder him from becoming a pupil of Listerism. At Bonn, Professor von Busch was enthusiastic. Indeed, the tale of antisepsis in Germany in the middle seventies would include the records of nearly all the leading surgeons. "Your procedure is unconditionally secure," was the testimony of Professor Hagedorn, of Magdeburg, to Lister. In this very security, perhaps, lies a monotony that may weary the reader. Yet how splendid is the record of places of disaster converted to places of renewed life which

Germany furnished even at this early date. In the Congress of German Surgeons held in Berlin in April, 1875, under the presidency of von Langenbeck, " there was but one voice, that of praise," said von Nussbaum of Listerism. " Professors von Volkmann, von Bardeleben, von Thiersch, Hüter, Schönbarn, and Schede could not find words enough to tell of the good of it." Yet at the same time a Congress of London Surgeons was being held with very different results.

Urged by many invitations from German surgeons, Lister himself paid a visit to some of the German University towns in June, 1875. Lister, said Sir Hector Cameron, his house-surgeon at Glasgow and lifelong friend, " had no great love of fame. When honours came they seemed always to cause in his mind a sense of surprise, and gave pleasure chiefly because he saw in them recognition of the truth and value of his work." His journey through Germany was the first occasion of those public recognitions that the gratitude of mankind showered upon his latter years. It assumed the actual character of a triumphal march. The greatest conqueror of disease the world has ever seen was regarded by the surgeons, students, and laity of the Fatherland as a conqueror indeed. He went first to Munich, the city of von Nussbaum. He was received with extra-ordinary enthusiasm, and a banquet was given in his honour, at which all the leading medical

men and the members of the Government and municipality were present. Eulogies, warmed by a profound and genuine gratitude, were delivered, to which Lister replied in the German language. The students of the University on their part prepared a special reception, and, one after another, speakers arose to describe the miraculous changes they had effected in the many hospitals of Munich, and to lay this record of mercy and healing as a unique tribute at the feet of him whom they acclaimed. At Leipsic the scenes were repeated. Professors, juniors, medical practitioners, and students clubbed together to the number of four hundred and gave Lister a banquet in the Schützenhaus. "Between the speeches," wrote a friend, "and throughout the course of the evening songs were sung by a quartet of students, and a band in the gallery played music of various kinds; amongst others 'Bonnie Dundee,' 'Coming through the Rye,' etc. There were also two songs composed by students for the occasion, which were sung by the whole mass of students who were present." At Berlin, Halle, Bonn, and Magdeburg Lister's reception was marked by the same profound gratitude and enlightened evidence. Lister returned to Edinburgh, feeling sure that the conversion of the whole civilized world to the same enthusiastic conviction would be only a matter of time.

In the country of Pasteur Lister also had many adherents, but the acceptance of his system was in no way so enthusiastic nor so enlightened

as it was in Germany. Antiseptics were in more or less general use, but without definite principle and plan, and the consequent beneficent results.

M. Duplay, editor of the *Archives Générales de Médecine,* published an account of Lister's methods in 1871. M. Lucas Championnière, as editor of the *Journal de Médecine et de Chirurgie Pratiques* and author of the first text-book of the antiseptic treatment, did his best to convert his countrymen. In 1877 M. Duplay devoted a revue critique to antisepsis. He acknowledged that Lister's was the only thorough and effective system. "It has been adopted by a great number of surgeons, not only in Britain but also in Germany, Denmark, and Italy. French surgeons, however, have not shown themselves much disposed to make use of it." The review was a comprehensive one, but cold. "Perhaps the whole success is due to the one fact that the surgeon himself has to attend to the smallest minutiæ of treatment," suggested M. Duplay in endeavouring to find an explanation other than the obvious one for a success he freely acknowledged. One is not surprised to find a visitor to Paris in 1877 saying: "The principles of Lister are so imperfectly understood by a good many French surgeons that I had shown me at various hospitals 'modifications' of his method in which everything is present except his principles." An attempt to make their ideas clearer gave "unintended umbrage" to Gallic vanity.

In Austria, in the large towns, antisepsis found more favour. Professor Billroth, who occupied the premier position in Vienna, sent Drs. Gussenbauer, Wöffler, and Mikulicz-Radecki in succession to Lister, so as to get information at first hand.

In Italy, as M. Duplay recorded, Lister's method also found more favour than in France. Dr. Clementi, of Catania, in Sicily, gave a full report of its use and progress in 1874.

Of the smaller European countries Denmark, under the leadership of Professor Saxtorph, could claim to be the first country in Europe to adopt Listerism with thoroughness. From Sweden came boracic acid, the use of which Lister greatly improved by devising boracic lint and ointment.

Amongst the Americans, a people practical in the day's affairs but wholly unphilosophical, the acceptation of Listerism was very slow. Lister himself visited the United States in the autumn of 1876, and attended the International Medical Congress in Philadelphia. He delivered an address, but his reception was not marked by any enthusiasm, and the discussion which followed was described by the leading New York medical paper as "quite interesting." Drs. Van Buren and Stephen Smith were the chief surgeons to take up the antiseptic method, but of a meeting of the American Surgical Association, which took place as late as July, 1882, the *Lancet*, secure in a recent conversion, reported: "Anti-Listerians were in the majority; . . . they

relied for support upon the statements of others. . . . Surely it is too late in the day to contest the truth of the germ theory."

The *Lancet's* earlier comments upon Listerism and the continental testimony to Lister, however, were in a different tone, and took the form of the misplaced humour of vanity. "On n'est jamais prophetè chez soi," was its aphorism, although untold suffering was being perpetuated in London. The *Lancet* even threw its own impotence in judgment as disproving Lister. "It has been very pertinently remarked," said a leader-writer in October, 1875, "that if the special merits of Mr. Lister's plan were really as great as they are alleged to be they should at the expiration of eight or ten years have declared themselves with overwhelming force and certainty." One sickens even now to read such an example of silly arrogance, which first by an obstinate stupidity refused to go and see and then with inconceivable vanity argued that because it was not convinced there was therefore little or nothing in the new, wonder-working system.

Yet not only had there been Lister's triumphal tour in Germany and the astonishing evidence it brought forth, but Lister himself at the British Medical Association's meeting held in Edinburgh in 1875 had used the occasion to give frequent demonstrations of his system and to inculcate care, seriousness, and sincerity. "It were far better that the antiseptic system should not be employed at all, than that it should be used

imperfectly," he had declared. "For such attempts not only end in disappointment, but throw discredit on the system. Some people seem to say, 'I have tried the thing and failed, and therefore, of course, the system is all nonsense.' I have seen it fail in my own practice, but under such circumstances I have always thought there must have been some mistake on my part, and I have endeavoured to discover where my mistake lay. But that does not seem to be the way in which the matter is viewed by some of our professional brethren." What was the reason of failure and apathy? The treatment and its effects were clear. Did the fault lay with him? "It seems to be a difficult thing for me to write the English language so as to make my meaning intelligible," he added caustically. Yet in spite of the Glasgow, Edinburgh, Copenhagen, and German evidence, and Lister's protests, the *Lancet* jubilantly reported that "there is less antiseptic surgery practised in the metropolitan hospitals than ever there was."

The London surgical world even went so far as to endeavour to set up rival systems of treatment, founded upon principles "quite at variance with those on which Mr. Lister's method is based," according to the *Lancet,* but in verity, founded on no principle at all. Soap and water in abundance and scrubbing brushes were used, but where was the first principle? What peculiar cause or condition of disease did the soap and water wash away? To this there should have

been an answer, if there had been first principles, but no answer was forthcoming. Or wounds were left exposed to the air—a method which in clean, small rooms was often very effective, but one that had no first principle, being purely empirical. Compared to the security and range of the antiseptic system these rivals, which the *Lancet* praised in making out the case against Edinburgh, were quiddling. Lister himself acknowledged that they had had some success, but were in no way comparable to the antiseptic treatment.

Von Nussbaum's language was more forcible: "Some one might reply, 'Before Lister's discovery people sometimes got well in a wonderful manner. Sound country folk endured amputation and healed forthwith. Mr. Spencer Wells has had wonderful results in ovariotomy without following Lister, and Mr. Callender in general surgery.'

"True, we do not deny it, but closer investigation shows how little there is in this attack. Of what use is it to mankind that one case heals forthwith and the others make the whole house reek with the stench and become deadly sick. But if one operates after Lister's method, all danger of such results are averted. . . . Against this the opponents of Lister produce Messrs. Spencer Wells and Callender, and yet both gentlemen have themselves supplied the answer.

"Mr. Callender works in the richest hospital in the world and acknowledges that he uses a

form of antisepsis, though not Lister's . . . Mr. Wells's hospital is like a private house, in the whole building there being only three or four patients. . . . Moreover, his cases, brought forward by Lister's enemies, really prove the opposite, for Mr. Sims analysed thirty-nine cases of death from Mr. Wells's figures, and found that twenty-four of them had died of acute blood-poisoning."

It was in this hostile state towards the Edinburgh antisepsis that the London surgeons remained until 1877. There were a very few exceptions, notably Mr. Tom Smith, who declared that the general hostility was quite unjustified unless Lister's system was tried *in toto* and found wanting. He urged a fair trial, and himself set about giving one. The great majority of London surgeons, however, in their vanity set themselves up as an insuperable barrier between the incalculable benefits of Listerism and their long-suffering patients.

A severe comment by Lister upon the inadequacy of the clinical surgical teaching in London gave an occasion for the scarcely concealed venom to break forth. The *Lancet*, amongst others, made itself the mouthpiece of the "howl of derision," a term by which one of Lister's devoted followers described this outbreak of the feeling of the London surgical world towards the Edinburgh professor. Mr. Lister was "like a man who in the excitement of enthusiasm raves at the false creations of his heat-oppressed

brain"; "he seems to have lost himself in infatuation;" "he so far forgot all the rules of decency and good taste as to contemptuously decline an offer that has never been made to him;" and finally this piece of envious belittling; "in many quarters Mr. Lister has acquired the reputation of a thoroughly painstaking surgeon, and has done some practical service to surgery by an insistence upon the importance of cleanliness in the treatment of wounds, although this has been done by the glorification of an idea which is neither original nor universally accepted."

The offer to which the *Lancet* referred had actually been made to Lister. It was that of the post of Professor of Surgery at King's College Hospital, rendered vacant by the death of Sir William Fergusson. In the form that it was made it did not permit of Lister giving clinical surgical lectures nor to take his own trained assistants with him. Moreover, King's College Hospital was one of the smallest London hospitals, and Edinburgh, by its world-wide fame, gave Lister the largest student field he could obtain. His father, whom he had greatly loved and frequently visited in London, had died in 1869, a few months before his father-in-law's death.

His nearest friends as well as his large private practice were in Edinburgh. The inducement to change was in no way great. Lister consequently declined the offer, not con-

temptuously, but with the refined courtesy that graced all his relations with others and made his charm deeply felt by all with whom he came in contact. London sustained "an irreparable loss," said the *British Medical Journal,* Lister's chief supporter.

The sudden outbreak of the hostility of London, demonstrated so fiercely against him, gave him cause to reflect. It called forth a counter-display of devotion on the part of the Edinburgh students, who had heard of the suggested change. A petition, signed by upwards of seven hundred students, begged him not to leave Edinburgh. "Your self-devotion to the advance of surgery, and your indomitable energy," it said, "have given us a mental stimulus for good, the effects of which it is impossible to overrate. . . . The welfare of our school is so intimately bound up with your presence, that its withdrawal must be an irreparable loss, not only to it, but to all of us, who would have to mourn the loss of a highly esteemed and greatly beloved teacher. We are far from disparaging that field to which you may be called; but we would venture to submit that nowhere will you find a more numerous or devoted band of followers than those who now count it their highest privilege to listen to your teaching." Lister was moved by this touching address, written from the hearts of his students, more than by any other honour that could have been paid to him. But, by showing

the conversion of Edinburgh, it emphasized the more the larger decision which he was called to face. As a man of the highest genius, he had gifts for the whole world of men. London proved the great stumbling-block to his dispensations, being beset with the belittling spirit of spite, which caused the *Lancet* to refer to the students' petition as "the seductions of flattery." The London medical profession had to be shaken from its apathy and arrogance and to be forced, not only to give the new salvation to its patients, but also to fill worthily the high place in the eyes of the world which the reputation of the great metropolis gave to it.

Lister wrote to the Governors of King's College Hospital that, in the event of his being given full opportunities for the teaching of clinical surgery, and being allotted separate wards to manage, to which he could appoint his trained Edinburgh house-surgeons, dressers, and nurses, he was now willing to accept the appointment. The terms were, of course, wholly without precedent, but so too was Lister. The Governors yielded, and Lister was made Professor of Clinical Surgery to King's College Hospital.

Accordingly, at the end of July, 1877, Lister delivered his last address to his faithful Edinburgh students. The address has not been preserved; a misfortune, for a brief abstract shows that it dealt with the philosophy and ethics of the medical profession, subjects upon which the

words of so great and noble a man as Lister possess an incalculable value.

When his students began to practise, he strongly urged them to keep always in mind that " their profession would always be an exalted profession, perhaps second to none in that respect. It was, on the one hand, fraught with the deepest scientific interest, and, on the other, it was a profession of pure beneficence, and in this respect would vie with the clerical calling. But if a profession of a lofty character, it was also a profession presenting temptations to the degradation and debasement of those who practised it. There were peculiar temptations in it to quackery in one form or another. They would find that their patients would repose unlimited confidence in them; and being thus implicitly trusted, and having no one to overlook them, they were constantly liable to profess what they did not know, and sometimes to do what their best feelings would tell them ought not to be done." He urged them, therefore, to take up every hospital appointment they could, and by knowledge and practical efficiency to be able to dispose of the temptation to make use of quackery.

Lister returned to London, his native city, as a combatant. Yet throughout his life his warfare was directed not against men but against the foes of mankind. Throughout the years in which his doctrine was meeting friend and foe, he showed neither temper nor impatience, but an

indomitable will and energy, a quiet irony towards his opponents, an invariable courtesy to friend and foe alike. His outward calm was never ruffled. No man ever conducted a campaign with such imperturbable serenity. A humorous poet described his qualities at Edinburgh in a long poem, of which the following is a selected stanza :—

"To work out this solution, tooth and nail,
With skill and labour at it Lister went,
Fully determined that he should not fail;
And many an hour, and day, and week he spent,
Racking his very brains till he grew pale,
And making many an experiment,
Until at last he found—it made him placid—
The true *solution* in Carbolic Acid."

And in like manner the author of "Rab and His Friends" depicted him: "You have only to look at his face to see how uninjured he has been in his walk through life."

CHAPTER XII

LONDON AND THE FINAL ACCEPTANCE

"AT this time of day it is well-nigh impossible for us to realize the boldness of this appointment," recently wrote an official of King's College as a comment upon Lister's appointment. The London hospital staffs at that date would admit no one from without. Although Lister had been house-surgeon at University College Hospital, his sixteen years in the north had marked him down as a foreigner to the metropolis. The *British Medical Journal,* however, used its powerful influence in Lister's favour, and devoted a leading article of welcome to him, who would add "to the glory and greatness of the surgical profession in London." The *Lancet,* the zealous advocate of Lister's Edinburgh appointment seven years previously, was now silent. In general the appointment was regarded in the light of a distasteful experiment, which the responsibility of the profession to the public had rendered imperative. Mr. Timothy Holmes, in a letter to the medical papers, expressed the peculiar London view. An experiment was to be made. The antiseptic treatment

was to be thoroughly tested, as it were, for the first time. All the Edinburgh, German, and other evidence was to go by the board. London would decide. Mr. Wood was a fellow-professor with Lister at King's. Mr. Wood, though he had spoken well of carbolic, did not practise antisepsis systematically. Messrs. Wood and Lister would have about an equal number of patients. The human deaths in each ward could be counted, and the general conditions compared. The test was a fair one. By it let the antiseptic system stand or fall.

Lister brought with him from Edinburgh his two house-surgeons, Mr. Watson Cheyne and Dr. John Stewart, two juniors and nurses, who were all trained in the antiseptic system and regarded their chief more than ever as Henley had seen him :—

> "We hold him for another Herakles,
> Battling with custom, prejudice, disease."

Dr. Stewart, in a paper read before the Academy of Medicine, Toronto, has given an admirable account of Lister's first London lecture, delivered at King's :—

"On the afternoon of October 1, 1877, Lister delivered his introductory lecture at King's College. I regard it as a memorable historic occasion. The subject of the lecture was bacteriology; it was perhaps the first on the subject ever given in London, and

as yet the science had not a name. The theme was the action of germs on milk and putrescible fluids, and he told of experiments he had carried on during the summer.

"Cheyne and I called at his house early in the afternoon. We found him in his shirt-sleeves, perspiring as usual, busy getting in order the exhibits for his lecture. Mrs. Lister was helping, also his nephew, Mr. Godlee, now President of the Royal College of Surgeons, who had prepared some very beautiful coloured drawings as illustrations. There was a large number of glasses and tubes, culture tubes we should call them, but that term had not arrived, some containing milk which had been acted on by various kinds of germs, and some which had been kept successfully from infection. These stood on plate-glass slabs and were covered by small glass shades. We drove from his house to the lecture-hall in Somerset House.

"We supported the trays and glasses as carefully as possible. They had been brought successfully all the way from Edinburgh, but were now in perilous passages; there were occasional awkward jolts, and they sometimes rattled terribly. I made some remarks about 'Cæsar and his fortunes,' and I well remember his gentle, amused, and somewhat pensive smile. Lister was well received. The spacious lecture-hall was crowded with an audience which contained not only many of the most distinguished physicians and surgeons of London, but some

of the leading scientific men. . . . Of the staff of King's, I recollect with most distinctness the dark, square face and piercing black eyes of one of his surgical colleagues, Professor John Wood, who we supposed was hostile to Lister and resented his appointment to the chair to which he himself had looked forward; and the benign intellectual face and silver hair of Dr. George Johnson, the most distinguished physician on the staff, who was one of those who had been active in securing Lister's appointment."

Lister chose his subject because of its inclusiveness. The causes of disease, which he had proved, covered a far wider field than that of surgery alone. It covered in all probability, as Lister said, all so-called infectious and contagious diseases, and therefore was of equal importance to the physician. So also was it vital to the obstetrician, accounting for those peculiar fevers of childbirth which proved so baffling and so fatal. To the surgeon its importance was supreme. The address itself contained the matter and arguments with which Lister's Edinburgh hearers were familiar. It was couched in simple and restrained language, that could give no offence to feelings which Lister knew were already sensitive. Lister allowed himself no oratorical display nor any reference to his or his disciples' successes. With careful reasoning he laid before his audience the basis of the germ theory, and concluded his lecture with these palliative words: "And thus

I believe that we have taken one sure step in the way of removing this important but most difficult question from the region of vague speculation and loose statement into the domain of precise and definite knowledge."

The address was followed in the evening by a dinner given to welcome the new professor. Many of Lister's friends were present and his future colleagues. The Principal delivered an address of welcome and Lister replied.

"This was a brilliant and most hopeful beginning," said Dr. Stewart, "of what we regarded as a campaign in the enemy's country. But whatever Lister's own thought may have been, the next few weeks were to us of his staff the abomination of desolation. There seemed to be a colossal apathy, an inconceivable indifference to the light which, to our minds, shone so brightly, a monstrous inertia to the force of new ideas.

"We four unhappy men wandered about, now in the wards of King's, now through older and more famous hospitals, and wondered why men did not open their eyes. In these wards the air was heavy with the odour of suppuration, the shining eye and flushed cheek spoke eloquently of surgical fever. We would show them how things should be done! But how? We had no patients! We thought of the crowded hours of glorious work in Edinburgh, where Lister had half a dozen wards and sixty to seventy patients, and groaned over two wards

with capacity for a couple of dozen, but only empty beds. We remembered the enthusiasm about the introductory lecture of a session in Edinburgh, when the theatre would be crowded with five hundred eager listeners, and our hearts were chilled by the listless air of the twelve or twenty students who lounged into lecture at King's. And when the patients did come they were curiously unfit to demonstrate the advantages of the new system."

Lister himself felt this indifference as keenly as his assistants. He said he used to hang his head when driving down to King's at the thought of devoting himself to the convincing of a handful of apathetic students of the value of a system which he believed was revolutionizing the world's surgery.

But in a month an opportunity presented itself. A man who had broken his knee-cap was admitted to Lister's wards. In such a case, in spite of the weak knee that commonly results if the leg is merely splinted, no London surgeon would have thought of cutting down upon the split bone and wiring the pieces together. The danger of infecting the knee-joint would have made such a procedure appear homicidal. Lister fearlessly cut down upon the split bone and joined the two pieces together with silver wire, a valuable operation he introduced into surgery. A distinguished London surgeon, hearing of this operation, said to his students: "When this poor fellow dies, some one ought to proceed against

that man for malpraxis." But of course that man's malpraxis did not lead to death, but to the patient's recovery with the injured knee as strong as the sound one. Soon after this, a patient with an enormous malignant tumour of the thigh was sent to Lister. The patient had been abandoned by other surgeons. It was a test case. Lister removed the cancerous limb. The members of the staff and students visiting this interesting patient were astonished to find him in a day or two sitting up in bed and reading the paper, being free from pain and free from fever. Mr. John Wood, Lister's fellow-professor, was one of the witnesses of this case. He at once abandoned the test which Mr. Timothy Holmes had proposed, of comparing the results of the two professors. He was generous enough to disclaim any kind of rivalry, and invited Lister to teach him the antiseptic method. Accordingly a patient with a goitre was set aside in a special ward. Wood operated, Lister assisted and supervised the antisepsis, the surgeons of King's and many other hospitals crowded in to see. The result was eagerly watched. The dreaded suppuration never appeared. The wound healed perfectly. From that time onwards the surgeons of King's were convinced, and John Wood, who was to have been Lister's rival in the test, became his friend and follower.

The most philosophic and famous of London's surgeons at the time was Sir James Paget. He

took an early opportunity of personally witnessing Lister's work. A case soon occurred, which showed the opinion he had formed. A young lady of good family suffered from a large tumour of the shoulder-blade, which caused grave disfigurement. Sir Prescott Hewitt, the President of the Royal College of Surgeons, was called in, but refused to incur the risk of the large open wound that the operation demanded. Sir James Paget was summoned. He also refused to operate, but advised the girl's parents to send for Lister. Lister operated at her home, for with his method an elaborate operating theatre is rendered unnecessary. Sir Prescott Hewitt and Sir James Paget were present. In a few minutes the tumour was removed and the operation at an end. The recovery was complete and without fever or pain.

Against such cases it was useless to argue. The attitude of the profession to Lister from now onwards becomes a more pleasant one to record. The great number of us are unable to appreciate the thought of genius, and if we criticize we fall into grievous errors. It is not until it has filtered down to us in practical results that we are able to appreciate it. But when convinced by practical success, then at least we hasten to repair our error of judgment by a loyal acknowledgment of the great gift. Then at last our attitude is a becoming one. We appear in our rightful place as faithful disciples instead of inept judges. From the time that Lister came

to London practising surgeons began rapidly to fall into their proper places.

Indeed, there was already a very definite stir of new life in the medical profession. In 1874 Mr. Erichsen stated "that surgery in its mechanical and manipulative processes, in its art, in fact, is approaching, if it has not already attained to, something like finality of perfection." But he had not reckoned with the discoveries of his quondam house-surgeon. Mr. Erichsen believed that the abdomen, the brain, and the chest would be for ever shut from the intrusions of a wise and humane surgeon. But some three years after the above words were written the new surgery was already doing such operations. The extirpation of ovarian cysts, which if left were fatal to the unfortunate woman who suffered from them, had been undertaken only as an operation of desperation, yet from sixty to eighty out of every hundred patients died. Mr. Keith and Mr. Spencer Wells alone had shown better results, and Mr. Keith was one of the first to trust to Lister's methods. But in 1878 from many sides excellent results were reported. Professor Schröder, of Berlin, reported fifty cases with only four deaths, two of which were due to cancer, and therefore unavoidable. Others also recorded like results, and a controversy arose as to which surgeon could most justly claim to be the first to undertake an antiseptic ovariotomy.

Daring operations upon bones for knock-knee, club-foot, and other deformities were devised

and carried out with success. New operations in other departments of surgery were devised and executed.

As might be expected, the countries which took the lead in antisepsis took the lead also in these new operations. Scotch and German surgeons were chiefly prominent. Mr. MacEwen, of Glasgow, was in the van in setting deformities straight. Drs. von Nussbaum and Schröder brought forward unprecedented statistics in ovariotomy; but Mr. Spencer Wells, of London, having adopted Listerism, worked with equal security and brilliancy. Dr. Matthews Duncan, Lister's colleague at Edinburgh, though now in London, Drs. Richter, Bischoff, Fritzsch, and many others in Germany came forward to show the extraordinary improvement Listerism had effected in childbirth in maternity hospitals and also in private practice. Dr. Grafe was eulogistic of the added power it gave to the eye surgeon. Von Volkmann reaped more success and dared bolder operations. Mr. Annandale, Lister's successor at Edinburgh, proved the safety of antiseptic exploratory incisions to aid diagnosis in doubtful cases of tumour. Mr. Barnes, of St. George's Hospital, showed the safety that Listerism gave to post-mortem operations, and its use in preventing the spread of scarlet fever and diphtheria beyond the sick-room.

The year 1879 may be called the decisive one in the history of Listerism.

It opened with the rise of an opponent, who

would have been formidable had he had a strong case upon his side. This was Mr. William Savory, who by an assertive dogmatism and capacity had earned for himself an unequalled reputation as a teacher of surgery. "He spoke as a great authority, delivering judgment on the problems of surgery." In this particular year he was chosen to deliver the annual address in surgery, and he took the opportunity of saying that whereas he believed in antisepsis and had a method of his own, he did not see Mr. Lister's method should "supersede all other methods in the practice of surgery." But Mr. Savory only won favour from the *Lancet*, which delivered one more attack upon Lister before its compulsory capitulation, and from Mr. Lawson Tait. Mr. Tait was a capable but eccentric man, who took especial delight in upholding a falling cause. With regard to Listerism he made the unique boast that "in my experience it was an almost uniform result that wounds dressed after Lister's method suppurated, and in many cases sloughed," results so eccentric that he was gently accused of not understanding the treatment. To this he replied: "My answer is that if the proper use of the dressing was above my intelligence it was useless for general application," a rickety syllogism upon which to base an opposition to a simple creed that had such powerful evidence to support it.

Mr. Savory and other opponents of Lister, finding that they could not disparage individual

cases, began to demand from him the statistics of his results. But Lister, with his usual clear-sightedness, had not the same faith in conversion by figures as he had by personal witness and experience. He had, he said, given his general results of Glasgow and Edinburgh in his papers on the Salubrity of Hospitals, but had not occupied himself with statistical details. "The truth is life is short," he said, "and that when every day begins one has to consider what is the occupation which is most likely to be valuable, and I have felt that there was every day something more congenial and, I hoped, more profitable to do than to compile statistics." Lister, in fact, betrayed that distrust of statistical proof of human truths, which is, I believe, characteristic of all the greatest—that is to say, the most directly human—men of genius, who deal with the life and the world as the field of personality and vitality, and not as a place to be accounted for by sterile ciphers.

Mr. Watson Cheyne, when surgical registrar at King's, relieved him of the distasteful labour, and published all Lister's results for a period of nine years. "The result shown," said the *British Medical Journal*, "is so marvellous a triumph over accidents known to be inseparable from a series of such operations till Lister robbed them of their danger, that they require no comment."

Nevertheless, the publication of these successes drew forth the last and bitterest attack against Lister. In this case the envy that prompted it

could not be concealed. The attacker was Mr. Spence, who had been Lister's fellow-professor of surgery at Edinburgh. Mr. Spence was a skilful practical surgeon, and under ordinary circumstances he would have taken Mr. Syme's place as the sustainer of Edinburgh's surgical repute. But his name and fame had been wholly eclipsed by the European reputation of his junior colleague. The visitors who came to Edinburgh thronged Lister's wards, but left those of Mr. Spence, who had adopted a modified antisepsis, scarcely visited. The latter began his attack by a disclaimer of any feeling of envy or uncharitableness, the usual disclaimer that betrays the consciousness of the thing disclaimed. He then launched out into an attack of considerable personal bitterness.

Lister replied at length with his usual restraint, tempered by irony :—

" Mr. Spence's article consists of two elements ; one tending to disparage my character as a surgeon, the other calculated to diminish the effect of the statistics which I lately adduced in favour of antiseptic surgery. The former of these elements I shall take leave to dismiss without further notice than the remark that, as Mr. Spence never did me the honour to witness the practice which he criticizes, so that his knowledge of it, beyond my brief descriptions of the cases, must have been derived entirely from hearsay, the exercise of a little charity towards a late colleague might have induced him, in every

one of the points to which he refers, to accord a more generous and at the same time a more just interpretation.

"But," he continued, with delightful irony, "in direct proportion as Mr. Spence succeeds in persuading the readers of the *Journal* of his own superiority and of my inferiority as a surgeon, must his argument tell in favour of antiseptic surgery; for if, in spite of such disadvantages, I am enabled, by the application of a new principle, to obtain results superior to his, the fact must speak volumes in favour of the principle."

Lister had little difficulty in maintaining his position against Mr. Spence. But the matter did not end, for Mr. Spence replied both to Lister and Mr. Cheyne in such a manner that the editor of the *British Medical Journal* struck out many "irritating and acrimonious personal remarks," and declared that "Mr. Spence's remarks with regard to Mr. Cheyne's contribution are scarcely worthy of so eminent a surgeon." Consequently he took it upon himself to close the discussion.

The decisive character of 1879 was evidenced by far more positive evidence than was the fate of these last attacks upon Lister.

The International Congress of Medical Science held its triennial meeting this year at Amsterdam. Five hundred medical men from all the countries of Europe met there, amongst them Lister, who was to deliver an address. The occa-

sion was one, therefore, upon which a public record of the continental feeling towards Lister and his work could suitably be given. What that feeling was is shown by the following account in the *British Medical Journal*:—

"Professor Lister was received by the whole Congress with an enthusiasm which knew no bounds. When he stepped forward to the desk to open his address [which was delivered, with but few notes, in improvised French] the whole assembly rose to their feet; and, with deafening and repeated rounds of cheers, waving of hats and handkerchiefs, hailed the distinguished Professor of King's College with acclamations renewed minute after minute, and time after time, as his name was again and again shouted forth by some grateful and enthusiastic acolyte. This remarkable scene—unprecedented, we imagine, in the history of medical science—continued for some minutes, until Professor Donders, the President, advancing with the distinctive grace and dignity for which he is remarkable, and taking Professor Lister by the hand, as he stood overwhelmed by this magnificent ovation, obtained a moment's silence, and, addressing him, said: 'Professor Lister, it is not only our admiration which we offer to you; it is our gratitude, and that of the nations to which we belong.'"

For what a vision of benefits bestowed could be seen by this quiet, grave man beyond the turbulence of waving handkerchiefs and out-

stretched hands, and the ebullience of a continent's enthusiasm. He saw wards, with their trim rows of beds, in which patients lay, bandaged or splinted but otherwise with cheerful faces of hope or peaceful faces free from the awful ravages of disease. No longer were the beds filled with suffering humanity, beaten down by pain and noisomeness that no power or skill of the charitable heart could avert. No longer did he note the feverish glitter of a restless eye seeking for help; the vivid patch upon the cheek, which betrayed the burning touch of a messenger of death; the black, encrusted lips through which the foul breath of a polluted body came in short gasps; the pinched face, from which fever had sucked forth all the juices and tissues of life; the terrible insanity known as euphoria, in which a patient on the verge of death is cheated by some horrible phantasy of restored health, and, trembling and feeble, makes the last hopeless efforts to creep from the bed in order to assure the doctor that all is well; or the ward-screen which surrounded the shrivelled corpse of yet another victim of man's misguided charity. No longer did he see in the surgical wards traps that concealed their deadliness behind the fair front of kindliness, nor in the maternity wards places where many a woman paid for the joy of motherhood with death or a lifelong tribute of pain. And when his vision ranged further afield he saw war robbed of its greatest horrors, the gnawing gangrene

and the burning pyæmia which destroy the wounded after the enthusiasm of battle has passed; he saw in private houses a safety that had previously been unknown; he saw surgery armed with security venturing into new fields of beneficence; he saw hygiene, based upon his principles, take from crowded cities the horrors of massed squalidity; he saw the factory system, which had shown itself so baleful in its influence upon the health and physique of men and women, controlled and cleansed by men trained in his teaching; he saw charity everywhere changed from an impulse of dangerous ineptitude to one of armed understanding; he saw the spread of the power he had given to mankind to more distant lands than those whose representatives greeted him; he saw not a hundred nor a thousand, but hundreds of thousands of faces infused with renewed health and happiness as the result of his unequalled gifts. What a vision for a man to see beyond the waving handkerchiefs and hats! How rightly had the poet proclaimed him "another Herakles," for it was he who had cleansed the Augean stables of the world.

After the reception at Amsterdam the tale of London's acceptance of Lister is subdued and English in its lack of outward emotion. It was generally felt that a decisive attitude must be taken. A general discussion upon antiseptic surgery by the leading London surgeons was arranged to take place at St. Thomas's Hospital.

The notable address of the meeting, besides Lister's, was that of Mr. William MacCormac, who had come to live in London. He was one of Lister's first followers, and now spoke overwhelmingly in favour of the antiseptic system. Messrs. Spencer Wells, John Wood, Jonathan Hutchinson, Thomas Smith, and Knowsley Thornton also expressed themselves convinced of Lister's methods and theory. Sir James Paget, who had been late in adopting Listerism, expressed in fine language the feeling of many a laggard surgeon. " I can compare my experience at St. Bartholomew's Hospital with one of my colleagues, Mr. Smith, and it makes me look back to that part of my life with remorse, and I may say that either through ignorance or inattention I had a mortality of which he could justly say he would be utterly ashamed. He has, during all these operations, used antiseptic treatment thoroughly ; and his success has been so great, in contrast with my failures, that I cannot for a moment doubt its value."

The meeting finally showed the success of Lister's decision to come and force London surgeons to be the dispensers of the benefits of the antiseptic system. In two years the conversion had been effected. It was not without reason that Dr. Ernest Hart, the editor of the *British Medical Journal*, whose advocacy of Lister had been so potent for good, summed up the results of this meeting in the words : " We heartily congratulate ourselves and the profes-

sion that Mr. Lister's coming to London has been so speedily followed by a signal triumph of that great principle in surgery, which had been accepted everywhere else almost before it was even listened to in London."

CHAPTER XIII

SIMPLICITY AND BOLDNESS

ONE of the finest combinations of two artistic expressions is, it is generally agreed, the song of the Erlkönig of Goethe and Schubert. The climax of the song lies in the pathos of the falling notes of the last terrified cry of the dying child. Yet Goethe's words are singularly simple: "*Der Erlkönig hat mir ein Leid gethan*" — "The Erlking has done me a harm."

The simplicity of the words are not merely the simplicity of a child. It is not a simplicity of innocence, but one of mastery. Probably no one but a poet of genius could attain a climax of feeling with so simple a line. The temptation of a more ordinary poet at such a time would be to make use of a more apparently striking expression. An English translation I have to hand, for instance, speaks of the child crying out that he had been seized in "an icy grasp."

Goethe, however, was able to be simple, able in spite of the emotion the words provoked to exhibit the mastery of simplicity and not the servility of the writer, who "abandons" himself to the violence of his feelings.

Such simplicity of mastery is only possible as the complement of a bold faith. Genius is the direct and intimate knowledge of nature, and its highest form is the direct and intimate knowledge of human nature. Goethe had such knowledge, and the proof is that, impossible though the whole story of the Erlkönig is, it is in fact so rooted in the reality of human feeling that again and again men and women have been profoundly stirred by it. Goethe knew men's feelings. He knew how powerfully he could provoke them with his poem of the strange mingling of imperious death and the beloved child; and, knowing this, he knew there would be no need for him at the supreme moment to shriek or shock by the advertisement of exaggeration. Sensationalism is the extreme of weakness, and is rendered necessary owing to the total inability of sensational writers to appeal to genuine human emotions. Goethe, on the other hand, boldly trusted to his knowledge of the human heart and dared simplicity—the Erlking has done me a harm. The simplicity founded upon a bold faith in a direct insight into the human heart proved to be the simplicity of mastery, and such was the resulting power that all have agreed to call the poem a work of genius.

The same qualities of bold faith in an immediate knowledge of nature and of a consequent simplicity of means in obtaining a desired result, I would submit, may always be found in the

works of genius, and are indeed distinctive of these works. Doubt, cloaked by exaggeration and confusing means to complexity, denote the works of lesser men. The genius, in fact, by the power and mastery he gains from his direct knowledge of nature makes life, or a part of life, simple.

The two qualities of simplicity and boldness are certainly very noticeable in the work of Lister.

The bold faith is shown in his basing himself, not upon the teachings of others but upon his own direct observation of nature in action, as evidenced by the pigment cells of a frog's web when injured and when recovering. Further direct observations of the frog's web, the outer coating of a frog's tongue, upon stagnant blood in a living blood-vessel and stagnant blood in contact with dead matter, confirmed his first-hand knowledge of the mystery of vitality. With a bold faith he turned his knowledge upon the question of wounds, discarded previous treatments, asked the advice of none, and confidently, on his own initiative and as a young man, proved himself upon living human beings.

The next quality to follow the bold faith of genius is simplicity of means.

This chapter, reviewing generally Lister's work and illustrative of his simplicity, it is hoped, will not be without interest to the general reader. Owing to Lister's very simplicity, the technical difficulties which arise in the discussion of many

scientific questions will scarcely arise in this discussion. In addition, the delineation of the nature of Lister's work will, it is trusted, also throw light that is not without value upon the general quality that characterizes the work of the greatest men of genius.

In the question of wounds, healthy animal vitality itself shows the greatest mastery. When an animal is wounded, and the wound is not mortal, one of two things happens. Either the cut surfaces glue together and the wound heals at once—healing, in the surgical phrase, by first intention—or the gaping wound fills up with blood and serum, which clots and forms a scab, covering and protecting the wound until it has healed.

The means Lister first adopted to promote the healing of wounds was to permit in civilized and injured man the formation of a hard and lasting scab.

In man, and especially in men in hospitals, this healthy scab did not form as a rule. Before it formed the blood, serum, and tissues, which in animals and also in men have an innate power of resisting the forces of decomposition and forming a scab, usually failed to resist and became putrid owing to the action of the germs of decomposition. The natural hard scab rarely formed, its constituents were resolved into putrefied liquid matter. Lister, by mingling the blood with carbolic acid, prevented this decomposition from occurring and permitted a healthy scab or

crust to form, under which the wound healed. Such a system of treatment was very simple.

In more serious wounds, however, there is frequently a free flow of blood and serum from the wound. In animals this flow nearly invariably gradually dries up, and then the scab forms. Any excess of discharge that continues then escapes from under the edge of the partly attached scab and collects in the hair or fur of the animal. There it dries, and, as the discharge ceases, firmly seals the scab upon the wound. In civilized man, however, the germs of putrefaction, which cause clotted blood and serum to become putrid liquids, usually, and in hospitals almost invariably, prevented this drying up and formation of a scab. Moreover, by the irritation they produced upon the tissues they promoted the formation and continuation of liquid discharge.

Lister, to prevent this, determined to follow with exactness the first principles of healthy nature. He first destroyed the germs of putrefaction that had obtained access to the wound, and he then covered the wound with a non-putrescible artificial scab. In short, by devices with carbolic he supplied that peculiar vitality which in wounded animals was capable of resisting decomposition and of permitting the natural mode of healing to take place, but which in civilized man was frequently wanting.

Lister's artificial scab, or dressing, therefore, had not only to possess this non-putrescible character, which carbolic gave it, but also the

three characteristics of a natural scab. Firstly, a natural scab is impermeable to liquid or dirt and forms a complete and unbroken shield to the wound. Secondly, it is flexible and elastic, and does not crack or crumble until the period comes when it is proper for it to fall off. Thirdly, when there is still discharge from the wound it allows this discharge to ooze out under its dependent edge until it ceases.

Lister's first attempt to manufacture an artificial scab was with the carbolic putty, which has already been mentioned. He spread the putty, made from chalk and carbolic oil, upon thin metal sheets, and placed this dressing, with putty face turned downwards, upon the wound. The metal sheet made this artificial scab impermeable, and the discharge from the wound passed through the putty and escaped into a cloth wrung out in a solution of carbolic, which covered the whole scab. But this dressing had objections. The putty stuck to the skin and was messy, and the metal sheeting was not nearly pliant enough for general use. The dressing could not be placed over the fold of a joint or anywhere where there was folding movement.

Lister consequently discarded the metal and spread the putty on stiff calico. He made a plaster of it, in fact, and not one plaster but "various kinds." But he found that the discharges soaked into the calico and made it sodden, so that it formed no proper impermeable scab at all.

Lister abandoned plasters and experimented with forms of carbolized paraffin. One of these "certainly made, under ordinary circumstances, an effective as well as an elegant substitute for the putty." But paraffin wax, though adhering cleanly to the skin, cracks and crumbles when moved. For this reason Lister found it unsatisfactory. In places where there was movement the dressing soon lost the character of a scab.

Lister once more returned to plasters, only to abandon them again. He then devoted his research "to obtain some kind of antiseptic cement." He found shellac the most satisfactory material. With carbolic acid and shellac he was able to make "a flexible solid with a certain degree of elasticity," which retained the carbolic well and was not "softened by either a watery or oily fluid." Here, apparently, was a perfect antiseptic scab. But the carbolized shellac had one fault. After a day or two it adhered so firmly to the skin that any discharge still existing could not escape from beneath its edge and remained pent up in the wound.

To avoid this adhesiveness Lister turned his attention to guttapercha tissue. As was his wont, he went to the first sources of information and paid visits to a guttapercha tissue factory. Dissatisfied with the sulphur caoutchouc, he got the manager of the North British Rubber Works to prepare some without sulphur and blended with shellac. He found by experiments that this tissue, whilst remaining insoluble in carbolic

acid, absorbed sufficient of the antiseptic into its substance to become itself antiseptic. He spread it out, melted some carbolized shellac, and, whilst the latter was hot, poured it over the tissue. The cooled shellac adhered to the tissue. Lister laid this preparation over the wound with the guttapercha tissue in contact with the wound and skin. The scab so formed was almost perfect. The guttapercha tissue was, however, apt to crack and also to separate from the antiseptic lac and allow discharge to fill the space between the two substances. Lister thereupon reversed the process of preparation. Instead of painting the lac upon the guttapercha tissue he spread the lac upon a soft cloth, and when cool painted its surface with a solution of guttapercha in bisulphide of carbon, " which, rapidly evaporating, leaves a coat of microscopic thinness." This microscopic layer he found was sufficient to take away the adhesiveness of the lac.

Lister now had a perfect artificial scab. It was antiseptic ; it was flexible ; it was impermeable ; and it allowed the discharges to escape from under its edges into the carbolized lint or towel that covered and overlapped it. Moreover, this scab had a further advantage. If a wound was such that no discharge from it was expected and a firmly adherent scab desirable, the thin layer of guttapercha could be rubbed off the shellac, the shellac brushed with carbolic, and its adhesiveness was restored to it. Lister had thus obtained an excellent carbolized

adherent or non-adherent scab. His faith in the direct processes of nature he converted into a very simple and practical form. One also sees the infinite capacity for taking pains, a quality exhibited by many who have not had genius.

Nevertheless, Lister was not quite content with the shellac and guttapercha. In nature he found that a scab had the capacity of absorbing small quantities of fluid from the wound and evaporating them off into the air at its outer surface. The lac and guttapercha failed in this quality. They covered over the wound and skin, but when the discharge had ceased to run for a time they had no capacity of drying up the track of it by absorption. Consequently the skin over which the discharge ran became sodden both from discharge and from perspiration. Lister experimented, therefore, with absorbent stuffs, and tentatively tried a dressing of oakum. The results were promising and led him to gauze. In the preparation of the gauze he displayed his usual indomitable patience and perseverance. He experimented in a number of methods. Finally he prepared a mixture of shellac, paraffin, and carbolic. The shellac fixed the carbolic and prevented it volatilizing ; the paraffin prevented the shellac from sticking to the skin. The mixture was melted and cheap muslin dipped into it and wrung out whilst hot. The fibres of the gauze, impregnated with carbolic, Lister found sucked up a fluid such as meat extract and kept it from putrefaction.

The first time that Lister made use of the gauze showed his bold faith in his own preparations and principles. He had been up nearly all night at his house in Charlotte Square, Edinburgh, putting the last touches to the preparation of the gauze, and, satisfied with his work, he went off to the infirmary in the early morning and made a large amount of gauze before his students, explaining to them the meaning of its various constituents and manufacture. With them he then went into the ward and selected a case for dressing, in which failure would have been disastrous. He was prepared forthwith to have his work proved by the severest test. His principles and anticipatory precautions did not admit of failure. The wound healed swiftly and cleanly with the new dressing.

Even now Lister was not content. The carbolic of the carbolized gauze was always slightly caustic to the wound. Consequently he entered into another long series of experiments, spread over a space of five years, which were as minute, as ingenious, and as triumphant as the series by which he established the absorbable ligature. As a result he finally produced the bland, double cyanide of mercury and zinc gauze. This is to-day the most perfect antiseptic gauze in existence, and is in universal use wheresoever antiseptic dressings are employed.

Lister was not yet done. At first he covered this gauze with a thin mackintosh sheet, which formed the impermeable protective shield of the

natural scab. But he was not wholly pleased with it, because, unlike the scab, it did not allow small quantities of fluid to pass through it and evaporate. The experiments of Pasteur had shown what an excellent guard dry cotton-wool was, entangling in its fine meshes all dust and microbes. A flask of sterilized animal fluid, if plugged with clean cotton-wool, was preserved against putrefaction. Lister confirmed for himself these experiments upon the filtering power of cotton-wool, and was also substantiated by some experiments of Professor Tyndall, who took a deep interest in the antiseptic system. Tyndall showed how a light-beam or sunbeam let into a dark room was rendered visible by the dust floating in the air. Air that was free of dust remained dark, and in a room in which the dust had been allowed to settle the visible light-beam was not formed. Tyndall arranged a light-beam in a room full of dust. He then took an ordinary pair of hand bellows and lightly plugged the nozzle with cotton-wool. He blew the air from the bellows across the light-beam. Where this air passed complete blackness resulted. The air was filtered free of dust by the cotton-wool and appeared quite black in the beam.

Fortified by this knowledge, Lister laid cotton-wool impregnated with carbolic over the gauze as a shield against the entry of microbes in place of the mackintosh sheet. Provided the wool was never soaked through to its outermost parts, Lister found this shield thoroughly effective.

The completed dressing now consisted of a layer of double cyanide gauze wrung out in a weak solution of carbolic. Over it were placed a few layers of the dry gauze, and over the gauze and overlapping its edges a mass of the protecting wool. Such was the final form the antiseptic scab took in Lister's hands and the one that is in use to-day. To my mind and to the minds, I suppose, of most medical men, it is impossible to conceive of a more perfect one. The solution of carbolic in the layer next to the wound and skin purifies them both, and in the early stages of the injury, owing to the sedative power of carbolic, takes away the pain. When this duty has been performed the carbolic, being volatile, escapes through the meshes of the gauze and wool and lets the bland antiseptic gauze unaided take its place. Outside the inner layer are the outer layers of gauze, which, if there is free discharge, suck it up and preserve it from putrefaction. When the discharge is slight its fluid evaporates through the gauze and wool and a dry scab of gauze is formed. Outside, covering and overlapping the gauze, is the further protection of the soft antiseptic wool, which, provided its outermost parts never become wet with discharge, forms a perfectly flexible and impenetrable substitute for the shield of the natural scab. It is, as I have said, impossible to imagine a work of greater simplicity and perfection. Out of all the vast variety of means and material Lister's selective power led

him to devise a dressing which joins imagination and reality together and annihilates the further completion of the complete.

The antiseptic technique which Lister devised for operations eventually reached a simplicity and directness comparable to the artificial scab which he devised for the dressing of wounds.

There were two means by which germs could reach a wound. They could be transferred by the fingers of the surgeon or dresser, by their instruments, sponges, or from the skin of the patient. The other method of transference was by the air.

Lister from the first knew of both and directed his measures against both. As regards the former method of transference, Lister and his dressers followed out a scrupulous cleanliness. At first he used to soak his instruments and sponges in carbolic oil, and found this method satisfactory as regards antisepsis. It is true that Professor Koch, the discoverer of the germ of consumption, proved by laboratory experiments that carbolic oil or any antiseptic oil was useless against microbes. But that which happens in the human body is often very different to that which happens in the laboratory. The laboratory is at the most only suggestive and not the judge of the body, though many scientists are apt to make it so. Lister's experience with the body and carbolic oil differed from Koch's experience with test-tubes and carbolic oil, and he found the oil's antiseptic powers satisfactory. It

was, however, greasy, messy, and made everything slippery. Lister was, therefore, glad to change it for a watery solution of carbolic.

Lister made experiments with the watery solution of carbolic (1–20) as regards its action upon hair, skin, nails, fat, and other living matter, and he found that the solution of carbolic had a peculiarity that rendered it particularly valuable. It parted very readily with its carbolic when it was poured upon organic matter. Living organic substance had, in fact, a definite selective attraction for carbolic, and Lister found that hair and other substances dipped into carbolic 1–20 took up so much carbolic that they became impregnated with it at a strength of about 1–5. Not only did they take the carbolic readily from the watery solution, but they also retained it well. Lister found that the skin of his hands dipped for half a minute or less into a solution of 1–20 carbolic retained the carbolic with such tenacity as to render his hands non-infective for all the time of an operation. This readiness of watery solution of carbolic to part with its carbolic was of the greatest use to Lister. "We shall purify the skin with a strong (1–20) watery solution of carbolic acid," he said before the members of the British Medical Association at Edinburgh in 1875, "which is the best for detergent purposes; water holding carbolic acid but slightly and very readily giving it up to act upon anything else. Carbolic acid has a remarkable penetrating property. It

blends with oily substances and animal matter and penetrates the hair and hair follicles, and therefore such a washing as I am now giving will render the skin absolutely pure surgically speaking. This is a very great point."

Armed with this knowledge, Lister devised an operative technique of extraordinary simplicity, which he followed with absolute confidence for thirty years of operative work. He made use of watery solutions of carbolic for cleansing his own hands and the hands of his assistants, the skin of the patient, the instruments, sponges, and the wound itself. The fuller account of this technique I will leave to the later pages of this chapter, when I come to contrast Lister's simplicity with the complicated methods of the very great majority of modern surgeons.

Against the microbes of the air Lister first guarded his wounds by uncovering them as little as possible and doing what he had to do with the utmost celerity. When the wound at an operation was bound to be freely exposed, he relied upon free irrigation to destroy any microbes that had fallen upon it from the air.

The entrance of air had always been regarded by surgeons as of extreme importance in the question of putrefaction. Pasteur's work had destroyed the belief that the oxygen of the air was dangerous, but it had not taken from the air its importance. On the contrary, it had

confirmed it by proving that germs and spores float about in the air of all inhabited places. Lister, therefore, basing himself upon Pasteur's work and his own confirmations of the same, paid serious heed to the danger of infection from the germs of the air. Consequently, when at the suggestion of two Edinburgh students the possible value of a carbolic spray passed through the air was proposed to him, Lister felt he ought to make a trial of it. A solution of carbolic was to be sprayed upon the dust of the air in the neighbourhood of the operation, as eau-de-Cologne is sprayed through the air upon the face. So Lister adopted it, and he and his assistants worked in air through which passed a fine mist of carbolic. At first the spray apparatus was worked by hand, then by the foot, and finally by steam.

There seems to be some incompatibility between Lister's character and the adoption of the spray. It is true, as one of his house-surgeons, the present Sir Watson Cheyne, said, that he was "very tolerant of the opinions of others and almost painfully conscientious," but such qualities were always controlled by his own bold faith in his own observations of nature and the need of simplicity. In this matter he seems to have been affected by the accumulative force of the widespread, traditional belief in the importance of the air, and this belief, supported by Pasteur's work, overcame his natural independence. He seems, consequently, to have

adopted the spray without testing it. He did not conduct a series of cases with the spray and a series without, and note in this way if the spray really lead to more perfect results. Nor did he expose a putrescible but sterilized fluid to the air, through which the spray was constantly made to pass, and thereby see if the spray really did prevent the germs of the air falling into it in an active condition and causing putrefaction. The consequence was that Lister, a man of great simplicity, became encumbered with a huge spray producer upon a tripod for which he had to have a carriage when going to private operations, and which was speedily dubbed by irreverent students "the donkey engine."

Nevertheless his character showed itself in a great dislike of the adopted encumbrance, and no doubt in so far as it was concerned felt the sting of ridicule, where otherwise ridicule failed to affect him. Nothing had as yet proved to him the spray's necessity, and he did not stand upon the firm ground of decisive results. Consequently he did not feel the security against the weapon of ridicule which a man feels when convinced of the value of his work.

His doubt and dislike continued, but he did not feel justified in abandoning the spray until he was assured of its actual uselessness. Nevertheless he kept a keen look-out upon all matters and facts that might bear upon the question of its necessity. Three years after leaving Edinburgh his scepticism was very marked. At the

International Medical Congress in 1881 he gave voice—and his voice was then amongst but not yet the weightiest in the world of surgery—to his scepticism: "The facts seemed to indicate that the putrefaction so apt to occur in wounds not treated antiseptically is due rather to septic matter in a concentrated form, than to septic matter in the diffused condition in which it exists, either in water or in air. They suggest the highly important question, Is the spray necessary?" "The spray," he answered, "is, beyond all question, the least important of our antiseptic means, . . . but if the apparatus for the spray is at my disposal, I for my part, do not as yet dare to abandon it." Six years later, however, he felt convinced that organisms did not exist in the air in a state of virulence making them a danger to exposed tissues, and also that the spray with its diffused mist was unable to destroy the germs of the air. Consequently he abandoned the spray. He found no evil results as a consequence of its omission, and therefore in 1890 at the International Medical Congress in Berlin publicly renounced it. "As regards the spray," he said, "I feel ashamed that I should have ever recommended it for the purpose of destroying microbes in the air."

Some have said it was a good thing that Lister introduced and then abandoned the use of the spray, for by so doing he proved the innocuousness of the air. But Lister was not one who needed such clumsy and circuitous

methods for his proofs. The work with the spray was, as a fact, the only superfluous work that Lister ever did, and it was the only method he adopted and made his own at the suggestion of others. What is more curious is that he adopted it and proclaimed it without positive proofs of its value. I can only suggest, as an explanation of this strange departure from his usual character, that the tradition of the danger of the air weighed with him with the astonishing power that a tradition continues to exert upon even a great and original man though he has himself rejected it in its accustomed form. It was this, perhaps, that made him accept without proof the fact of the existence in the air of germs able to set up putrefaction in dead organic matter outside the body, as evidence that the air also bore germs in a condition able to set up putrefaction in the organic matter of wounds.

With the abandonment of the spray, Lister's antiseptic system assumed the simplicity and direct relation to natural observations that was conformable with his character. It consisted of the artificial scab as a dressing and the use of a watery solution of carbolic as the means of his operative antiseptic technique.

In this general review of the character of Lister's work, we now come to the important question of its relation to the so-called aseptic treatment of wounds, a question which by contrast throws considerable light upon the qualities

of genius and those of more ordinary, if highly talented, men.

Lister, in the early years of his work, sought to avoid as far as possible the irritating effect of carbolic upon a raw wound when kept in contact with it. The carbolic, by its powerful effect upon microbes in the wound, slew them, but this strong action upon the living germs was not without some caustic or irritating action upon the living and injured tissues. Lister consequently sought to kill the germs in the wound and then to leave the wound itself covered by some blander substance than carbolic, under which the tissues could rest and recover. Over this bland substance he placed his carbolic guard, consisting of lint or a towel rung out in a solution of carbolic, or at a later date the carbolic wool. Quite early in his work he recognized this ideal of removing the antiseptic or carbolic guard from actual contact with the wound as soon as it was safe to do so. Thus in a lecture delivered at Edinburgh in 1870, he said: "Of all those who use antiseptics in surgery, I suspect that I apply them least to the wound. After the first dressing, the object which I always aim at is to have the material in contact with the exposed tissues approximate as closely as possible to the perfectly bland and neutral character of the healthy tissues."

This principle of keeping the irritating carbolic at a little distance from the wound also found its analogy in the natural scab, the under

surface of which is bland and moist, the outer or protecting surface of which is hard and not fitted for contact with delicate tissues. Cleanse the wound thoroughly with solution of carbolic at the first dressing, said Lister, but after that keep the carbolic as much as possible from the wound. The warning was needed, for many surgeons, hearing of the antiseptic treatment and attributing its miraculous powers to carbolic, concluded that the more carbolic they used the more efficacious their treatment would be. Acting upon the principle that one cannot have too much of a good thing, they filled large kettles with solution of carbolic and poured it in cataracts upon the wound. Wherever there was pus, or likelihood of pus, they injected syringefuls with a freedom that took no account of the irritating effect the continued use of carbolic had upon the living tissues. Lister distinguished himself from them by the faith he showed in the recuperative powers of cleansed nature. They, on their part, trusted to the recuperative powers supposed to be consequent upon their busy interference.

The errors into which these surgeons fell occurred before Lister's work had been freely discussed by the medical profession. The next exaggeration of Listerism, the so-called aseptic treatment of wounds, arose after Lister had published his perfected treatment.

Lister introduced the bland double cyanide gauze in 1889, and it was from 1890 onwards

that the exaggeration of his principle of keeping the carbolic from the wound after the first cleansing, and a bland substance in contact with it, developed into a new method, or number of methods, which pass under the wrongful and misleading name of the aseptic treatment of wounds.

This treatment came into vogue ten or more years after Lister left Edinburgh, and has now largely superseded Lister's methods both in hospital and general practice. It is said to be an improvement and a step in progress, but when more ordinary men claim to improve upon the system and practice of the greatest genius surgery has ever known, one is warranted, perhaps, in being suspicious. And a little investigation shows that whereas surgeons in the early days of antisepsis made a fetish of carbolic, so in these latter days men of necessarily inferior calibre to Lister have exaggerated his principle of keeping irritating antiseptics as much as possible from the wound to a fetish, and even claim thereby to have superseded Lister's method. In such a criticism one runs the risk of being accused of a disbelief in progress, and I must confess that when progress follows upon the work of one of the world's great men, my anticipation is that it will be progress downhill. In this particular instance there can be little doubt that the progress in the treatment of wounds since the perfection of the antiseptic system, in elaboration, complexity, expense, and decreased safety, has been of a downward character.

The difference between Lister and these "unfaithful followers," as Lucas Championnière, the famous French surgeon, has called the devotees of the aseptic treatment, affords an admirable contrasting picture of the bold faith in nature and the simplicity that distinguishes the work of genius with the elaborate character and lack of resemblance to nature that characterize the work originated by ordinary men. It also illustrates the wrong way of making use of and showing homage to genius.

Lister's principle was to render the wound, the neighbouring skin, his own hands, and his instruments germ-free by means of an antiseptic, his favourite being carbolic. To denote the germ-free condition he chose the word "aseptic," from the Greek ἀ, negative, and σήψω, I make putrid, a word which, it was later pointed out, Hippocrates himself had used. After making the wound aseptic with carbolic, Lister kept it so by placing over it an artificial non-putrefying scab, choosing for contact with the wound the most bland and non-irritating antiseptic he knew —namely, the double cyanide of mercury and zinc.

I have already endeavoured to show how close is the resemblance between Lister's artificial scab and the natural scab. His method of making the wound aseptic also bears a close resemblance to Nature's methods, a resemblance not generally recognized by practical surgeons who lack both the philosophic temperament and training. For

the living tissues and their juices have themselves an antiseptic power, Lister, as one might know, being the first to point this out. They themselves have the power of killing germs or rendering them harmless, for "without it," as Lister pertinently remarked, "surgery in former days would have been absolutely impossible." Life itself would have been impossible, for the smallest cut, admitting germs against which the tissues had absolutely no resisting power, would necessarily have become the door to general putrefaction. In man, however, and especially man in hospitals which bred germs of peculiar virulence, this antiseptic power of the blood serum and tissues was not sufficient to prevent putrefaction occurring. Lister, by the use of carbolic acid, supplied the deficiency. The virulent microbes of hospitals, being constantly defeated, lost their virulence, as all constantly defeated things do, and the peculiar diseases they caused died out. The antiseptic power of the body plus that of a solution of carbolic proved an invincible alliance, the only defect being that the concentrated and prolonged presence of carbolic irritated the tissues it had aided. In the double cyanide gauze Lister found a non-irritating ally, but for the initial work he knew no fluid that excelled carbolic. Had he known of any there is no doubt he would have used it. But what the carbolic did was only what the tissues and the blood also do—namely, it killed the germs or rendered them harmless. The resemblance

between it and the natural process of defence is an exact one, and as close as the resemblance between Lister's dressing and the natural scab.

The practitioners of the so-called aseptic treatment, on their part, adopted methods which bear no resemblance to the defensive methods of Nature. Instead of following the antiseptic powers of the body and the defence of the scab, they attempt to create a germ-free world in which to operate and dress wounds. To attain this ideal they rely upon an extravagant, elaborate, and cumbersome procedure. By this they attempt to boil and so render germ-free all the little world in which the patient, surgeon, and dresser have their being. They use the antiseptic power of steam and boiling water to overcome the myriads of enemies, some of whom would otherwise find their way to the wound. The general boiling has to be very thorough, and requires elaborate apparatus and a great expenditure of time and substance in order to prevent some microbes slipping into the wound by accident. Then, once there, the unaided antiseptic powers of the body may not be sufficient to deal with them.

A careful surgeon, devoted to the most modern rather than to the most inspired treatment, will, before operating, boil himself as far as it is humanly possible. Preceding serious operations, ideally always and actually as often as possible, he comes direct from the artificial boiling of a Turkish bath. After scrubbing his hands and

arms with soap and water and a boiled brush, he is robed in boiled garments, pulled out of a boiled case by a nurse who is wearing boiled gloves. She also fits a boiled cap over his head, a boiled mask over his face, and a boiled bag over his mouth and chin. The room or theatre in which the operation is to be performed is so built and ordered that it can be swilled and steamed, for where boiling is quite impossible there perforcedly the antisepsis of chemicals is used instead of that of boiling water. All its corners are rounded, its floor mosaic, nothing touches the smooth walls, there is no lodgment for germ or dust. The dressings are boiled, the dishes boiled, the sponges boiled, the soap and brushes boiled, basins are boiled, bags, gloves, mackintoshes, etc., boiled. The assistants and nurse in charge are also in boiled garments and addenda, and any students or visitors who attend the operation to gain knowledge meet with the same fate. The skin of the patient in the area of the operation is cleansed with the old antiseptics —in ways that are unnecessary complications of Lister's simple method, as will be shown—for as yet no method of boiling or steaming the patient's skin without harm has been devised. After the operation a boiled dressing is bound over the wound. This dressing, placed over a clean wound that has been closed by stitches, forms, it is true, an efficient and bland covering. In fact, Lister himself was almost certainly the first man to make use of such a dressing, some-

times when at Edinburgh covering clean, simple wounds with cotton-wool which he had sterilized by heat. It is significant, however, that as a result of his trials he never publicly recommended this dressing. The reason for not doing so is clear. In a wound, and especially an open wound, such a dressing forms no hindrance whatever to putrefaction arising. Hence, in a wound so dressed there is always a risk of it becoming infected from without—at least, until the day of the surgical millennium arises when a boiled patient in a boiled nightshirt will be kept in a boiled bed in a hospital that knows no dust or dirt.

By this elaborate boiling and steaming the antisepsis, which Lister used as an ally acting in conjunction with the natural powers, is not used in or over the wound, but by a complicated ritual is spread over the whole peripheral environment, whereby a surgical hospital, its inmates, officers, and equipment are kept as much as possible in a boiled condition.

The method, though it has arrogated to itself Lister's term of "aseptic," is obviously not a peculiar method apart from antisepsis. The properties of steam and boiling water that are used are their antiseptic properties, exactly as it was the antiseptic property of carbolic and other chemicals of which Lister made use. There is no possible justification, except mental confusion, for the change of name to the aseptic treatment of wounds. It is essentially an anti-

septic treatment, the anti- or against-sepsis or putrefaction resulting, as all successful antisepsis does, in a condition of a- or without-sepsis. The treatment only differs from that of Lister in two features—firstly, its far greater complexity, and, secondly, in the uncertainty and defects that always accompany any system that is not based upon a first principle in nature. For there is nothing parallel to this peripheral boiling in nature. There is no part of the world where animals are protected from putrefaction owing to that part of the world being germ-free. Even polar bears have microbes in their skin and fur, and in the torrid zones the same sun which purifies the air also by its warmth encourages the growth or prolificness of microbes. It is by their vitality that animals overcome germs. They are saved from disease, not by a complete and total absence of germs in their environment but by their practised strength and skill in destroying their enemies.

The question between Lister and his " unfaithful followers " is in no way merely an academic one. There is a distinct danger in this unfaithfulness of lesser men towards Lister's consummate genius. To see with Lister's clarity and to interpret experience with his penetration requires Lister's quality. Set a lesser man out upon the same path and by no means can he succeed to the same perfection. A nobler and proper attitude for him is, therefore, to show a faithful adherence to the directions of a man

of far greater gifts. A freedom permitted to him and to those like to him, a freedom allowing him to " improve and modify " the completeness of genius, is bound to terminate in a medley of confusion.

Man should confirm the inscrutable decrees of Providence, which pick out one man and endow him with supreme genius, by preserving his incomparable value in a firm tradition. But when an ideal of liberty scouts pre-eminence with its consequent dictatorial authority, and one of progress scoffs at the stability of tradition, then the true value of the insight of genius into the supremely difficult secrets of Nature and a general strengthening of man's power over Nature is sure to be depreciated and in a great part cancelled.

If the reader agree with these broad grounds of criticism, he can realize that a distinct danger may have arisen by which the public are likely to lose or actually are losing the inestimable benefits of Lister's creative generosity. And he may, moreover, be disposed to see that this loss is not wholly the fault of modern medical men, but is also due to an age in which liberty and progress as ideals have jealously destroyed the equally legitimate claims of authority and tradition to a place in the human economy. For the wisdom of preserving greatness by tradition cannot be questioned. Indeed, if no such tradition is formed the efforts of greatness become almost as ephemeral as the deeds of

ordinary men, and all life is reduced to a state of empirical mediocrity.

Howsoever this may be, there can be little doubt that a method that is simple and efficacious is, upon a priori grounds, more certainly the work of a master than one that is complicated. The character of Lister's full operative technique, which he himself pursued for thirty years of operative work of unparalleled cleanliness, is astonishingly simple compared to the technique of the so-called aseptic surgeons.

The first step in operative technique is in the rendering of the skin of the patient in the region of the operation aseptic or free from infecting germs. Lister tested and understood the way in which a watery solution of carbolic parted with its carbolic to skin, grease, and hairs. He therefore washed the area of operation with a solution of carbolic (1–20), and then left it covered with a cloth wrung out in this solution whilst the ordinary preparations for the operation —such as the anæsthetization of the patient—were being made. Other surgeons began twelve to twenty-four hours before the operation, and have devised imposing performances with soaps, ethers, alcohols, turpentines, corrosive sublimate, biniodide of mercury, and many other combinations of capriciously favoured solutions and chemicals.

This they do, although on many occasions, and notably in an address at King's College in 1893, Lister expressly said: "It is of great

importance that we should not make things unnecessarily complicated" (*i.e.*, as regards cleansing of instruments). "So also with the purifying of the skin of the patient. It is not needful to apply an antiseptic lotion for hours together, as is sometimes done; a few minutes' action of the 1–20 carbolic solution is really sufficient. . . . Carbolic acid has a powerful affinity for the epidermis, penetrating deeply into its substance, and it mingles with fatty materials in any proportion. Corrosive sublimate solution, on the other hand, cannot be expected to penetrate in the slightest degree into anything greasy; and therefore, as the skin is greasy, those who use corrosive sublimate require elaborate precautions in the way of cleansing the skin—treating it with oil of turpentine or ether, not to mention soap and water, to remove the grease, which they feel it is essential to get rid of, for the efficient action of the corrosive sublimate. Now all this is unnecessary care, if you use carbolic lotion. I can testify to this from very ample experience. For my part, I do not even use soap and water. I trust to the carbolic acid, which, by its penetrating power and great affinity for organic substances, purifies the integument as corrosive sublimate cannot."

The difference between the faithful and unfaithful follower would be best appreciated by actually witnessing their several performances. The faithful follower to cleanse the skin wets the whole operation area with carbolic lotion and

covers it with a cloth wrung out in the same lotion. This simple procedure completes the cleansing.

A far greater ceremony is conducted by the second. Overnight the nurse or dresser has already begun the performance by shaving the area, if there were hair to shave, and laying antiseptic wrappers upon it. When the patient is lying upon the operating table under chloroform or ether the surgeon or his assistant removes the wrappers with forceps. A small, wide-necked boiled bottle containing ether is held towards him by a nurse. Into this fluid a boiled sponge or swab held by boiled forceps is dipped. The skin is then sponged with ether. Another small bottle is uncorked and held up, the ceremony is repeated, and the interested spectator will note that the skin is now yellow. A third bottle is held up, another boiled swab soaked in it, and then the spectator will see that with each sweep of this swab the yellow skin is restored to its natural colour. A fourth bottle is held up, and the visitor may detect the peculiar odour of alcohol and note that the skin first pales and then reddens under its application. The nurse again steps forward, this time holding up a tin from which the surgeon picks a large piece of lint or gamgee tissue, which by its faintly browned appearance may show that it has been baked for a considerable time. This is spread by forceps over the cleansed skin, to lay there until every one is ready to begin ; the ceremony

is at an end, and the visitor, it is to be hoped, duly impressed. He might, in fact, come to the opinion that the unfaithful follower by his greater claboration was the more careful and trustworthy of the two, unless he always kept before him the value of simplicity; for men are apt to be impressed by pomp and show, and to mistake these advertising qualities and concoctions of vanity for merit. And in show the unfaithful followers of Lister certainly outstrip him, but not in final efficacy, for the purity of wounds which he achieved has certainly never been surpassed, and has only been equalled by some of his most faithful and discerning pupils.

Lister's method of preparing himself and his assistants for an operation possessed the same simplicity. He took off his coat and put on another or an apron to protect his clothes. He then turned up his sleeves. He washed his hands in soap and water, rinsed off the soap in clean water, and then dipped his hands for some seconds into the solution of carbolic. The skin took up the carbolic and rendered his hands antiseptic even for a long operation without further trouble.

Lister did not use the nailbrush, which he regarded as superfluous. He did not scrub his hands for so many minutes by the watch nor soak them in several lotions. He did not use boiled gloves, boiled robes, boiled cap, boiled mask, or boiled muzzle. He remained an ordinary human being to the eye of the spectator.

He was not attired like a mummer at a carnival. He never adopted all these "improvements," for the reason that he had faith in his own observations of the power carbolic possessed of rendering and keeping organic matter aseptic. His faith was justified. The cleanliness of his results, as has been said, has never been surpassed. Year after year went by and never a wound under his charge went wrong.

It was the same with regard to the rendering of the instruments aseptic, the same contrast between Lister's simplicity and bold faith and the complexity of the boiling and steaming method. The instruments were always scrubbed with soap and water, dried, and put away after an operation. Immediately before the administration of the anæsthetic in a new operation they were taken out, put into dishes, and well covered with carbolic solution. "This same 1–20 carbolic solution is what we use for purifying our instruments, our hands, and the skin of the patient," said Lister in the address delivered at King's College in 1893. "For the instruments, it is very much more convenient to be able to purify them by a solution like this than to boil them as is sometimes the fashion at present. For private practice it would be a most troublesome thing to boil your instruments." That this method of Lister's is quite as reliable as boiling his own long experience places beyond doubt.

There have, of course, been protests from the

faithful followers at this departure from Lister's masterful simplicity, but the voices raised have been few. Sir Hector Cameron, in the Watsonian lectures of 1907, said that the elaborate complexity of modern-day methods compare badly with the simplicity of Lister. They are quite unsuitable for general practice. "Precautions are taken as regards architectural and mechanical arrangements, the amount of skilled assistance required, and the use of gloves, masks, and other accessories, all of which are in their entirety quite incompatible with ordinary practice. Surgery is thus converted into a pursuit which, at least in its ideal manifestation, can only be carried on successfully in a splendidly equipped hospital. . . . The author of antiseptic surgery deplored the complications to which I have referred, which he knew from his experience to be wholly superfluous."

Dr. Lucas Championnière, the greatest of French surgeons of to-day, the pioneer of Lister's methods in France, and, like Sir Hector Cameron, Lister's lifelong friend, is more emphatic concerning "the unfaithful followers of Lister." "With asepsis," he said in 1902, "the position is much more serious. This surgery is nothing more than laboratory work" (founded on Koch's and others' experiments in test-tubes). "Never before have the architects been more indispensable. The least defect in the condition of an operation-room manifests itself by disasters. If the surgeon do not surround himself with im-

practicable precautions—masks, gloves, etc.—the safety of the patient is imperilled. The old surgical world protested against the easy and regular precautions which Lister took. Modern surgeons, instead of moderating those precautions which might be moderated, introduce new and incredible precautions incompatible with regular practice.

"And yet have they altered the results of surgery? Certainly they have caused it to lose its safety. That which Lister assured—the mathematical safety of surgical work done in accordance with the precautions indicated applicable under all circumstances, in all places, with all patients, and without lengthy preparation—that security has disappeared. Doubtless the surgeon who devotes so much attention and so large an expenditure to this new task has not gone back to the murderous surgery of thirty years ago, to the customary mortality from erysipelas and purulent infection. But look closely to his surgery. You will see how often little accidents occur, how often breaking down of primary union and secondary suppuration are met with. Even examine the statistics and you will see how many disasters occur from time to time, testifying to the inadequacy of their laborious precautions.

"Let us take, for example, the surgery of the joints, so easily infected during an operation. We shall see that it has been sown with disasters which antisepsis averted." It is the same with

other points of surgery which are most sensitive to infection. The buried ligature is an instance. Even the laity are nowadays only too familiar with the protracted discharge and irritation of a so-called stitch sinus. " Lister's simple directions for preparing it " (the catgut ligature) " afforded an excellent absorbable ligature. Why do surgeons seek ceaselessly for a modification of this? Why are many of them incapable of making use of this absorbable ligature? It is because they are unfaithful to the doctrine.

" It is not on account of my surgical skill that for twenty-five years I have used absorbable catgut without failure, probably oftener than Lister himself has used it. It is due solely to my fidelity to antiseptic principles."

Dr. Oscar Bloch, Professor Saxtorph's junior colleague and successor in Frederik's Hospital, Copenhagen, was equally emphatic on the need of faithfulness in an address to his students in 1902: " We could show you a whole row of patients who illustrate the same ideal wound course. And we are, as you know, in a hospital that is a hundred and fifty years old, and that lacks all those things which one nowadays calls surgical comforts, and in an operation-room where we are compelled to expose numerous things that can harbour particles of matter. Here are no rounded corners or smooth walls—and then—there is no danger in the portrait hanging on the wall. For it is Lister's portrait! Why such good results? Because Lister has intro-

duced the antiseptic system . . . which means precaution added to safety."

Finally there is the opinion and evidence of Lister himself. "Any material that is merely aseptic," he said in 1893, "such as cotton-wool or gauze sterilized by heat, having nothing in its substance to check in any degree the development of microbes, will allow the septic evil to spread freely to the wound from the external world if blood or serum happens to penetrate at any point to the exterior. In addition to this fatal objection such a dressing has other disadvantages. The necessary sterilizing apparatus, though it may be provided at a public institution, cannot well be at the disposal of the private practitioner. And, further, the merely aseptic material, having no power to correct any accidental defilement, must require an almost impossible degree of care in its manipulation. I have seen this system in operation in very able hands with results by no means satisfactory."

Lister could secure his results with mathematical accuracy. The unfaithful followers have no such security. From the very first their vanity in attempting to improve upon Lister has been punished by many failures and tragedies that could have been avoided—failures and tragedies whose hardships were visited, not upon them personally but upon their patients. In very able hands all professionally acquainted with surgery, like Lister himself, have seen failures and even tragedies. In less able hands one wrathfully

witnesses at this day a harvest of avoidable disasters, mostly partial, some fatal. The very initiation of the "aseptic treatment of wounds" presaged its future. It was founded upon that combination of mouth admiration of Lister with personal ignorance of his work which often characterizes the "improvers." Professor von Bergmann, of Berlin, was the chief champion of the improved methods, and the authoritative text-book of Dr. Schimmelbusch, the "Aseptic Treatment of Wounds," was founded upon the former's work. Writing even as late as 1893 Schimmelbusch paid mouth homage to Lister, calling him the chiefest of stars in the surgical firmament, and at the same time showed his own and his chieftain's crass ignorance of Lister's work and principles by describing Lister's Glasgow and Edinburgh dressings as ones that completely sealed the wound, adding the superfluous comment obvious to all that such a treatment by damming back secretion in the wound "is futile and even dangerous." Far more futile and dangerous are improvers who are ignorant of the first principles of that which they set themselves to improve.

The uncertainty which attaches itself to the aseptic treatment was singularly demonstrated upon a highly critical probational occasion. At the International Medical Congress held in Berlin in 1890 Professor von Bergmann himself reserved for Lister's inspection some cases of removal of the breast as examples of the aseptic

surgery. A number of doctors interested in the rival systems accompanied Lister upon his visit. Von Bergmann, inebriated with results emanating from the laboratory as some Germans are wont to be, and anticipating similar results in the human being, took hold of the edge of the dressing in order to roll back the curtain and reveal the triumph of a method which had superseded that of the great Englishman. It was, indeed, a moment of pride. Everybody stood upon the tiptoe of expectation. Von Bergmann rolled back the dressing from the first case, from the second, from each one in turn, and each case revealed, not a sweet, clean wound, but the old picture of suppuration and decomposition. By some chance each case had become infected, and there was no antiseptic to kill the infection at its birth. Lister, watching with grave interest the results of the improved method, is said to have displayed upon his features the liveliest astonishment.

So it is at this day. The text-books from which we learn our surgery are full of warnings rather than promises of security to them that loyally follow their instructions. "It should not be lost sight of, however, that wiring of the patella has been followed by suppuration, stiff joint, amputation, and even loss of life;" "Occasionally a virulent or even fatal infection is started by catgut;" and suchlike sentences alarm both student and practitioner with the terrible uncertainty of their art. The avoidance

of septic disaster—quite apart from surgical skill—instead of being represented as a reward of faithful adherence to Listerism, is shown to the student to be dependent—and even then it is not assured—upon an enormous and expensive equipment of various forms of sterilizers, autoclaves, mosaic floors, tiled walls, sterilized water, air-filterers, highly trained assistants, boiled robes boiling in a short time to rags, boiled gloves soon becoming rotten, boiled instruments soon becoming blunt, architectural rotundities and mechanical specialities, which can only be enjoyed at hospitals by the charity of the public and at nursing homes by the largeness of fees, by quite a limited number of surgeons. The certain benefits of Lister, which could have been spread through the land in cottage as well as palace, have been converted into a ring and a fetish. The student walking the hospital, instead of being taught the beautiful simplicity and mastery of Lister, is like an acolyte instructed in mysteries; but should he not join the ranks of the peculiar priesthood he eventually finds himself turned out upon the world, dubious and incompetent, because he has not at his beck and call the elaborate paraphernalia of a palatial modern hospital. Surgery, in a word, has been not only rendered unsafe, but it has been made an expensive monopoly of the surgeons who get attached to the public hospitals. Not only does the student and future practitioner suffer gravely from this rapid departure from the simplicity of

Lister, but the ever-increasing cost to the public is enormous. The need of asepsis, says a writer upon the London Hospital and its construction and outfit, which he much admires, "had led to an enormous expenditure, which becomes a fixed and permanent expenditure." This is no place to enter into a comparative study of this expenditure, which has to be begged from the purses of the benevolent or exacted from those of the ratepayers. I only desire to contrast the masterly simplicity of genius with the pomp and exaggeration of men without the rare and peculiar gift.

Even Lister's most devoted friends and followers did not become fully imbued with the wonderful simplicity that characterized the master. Upon the occasion of Lister's eightieth birthday, in 1907, it was considered that no memorial could be more appropriate than a collection of his scientific papers. These papers were widely scattered in different periodicals and publications to the misfortune of the profession. The idea was an excellent one. Lister agreed to it, and a committee of his nearest friends and followers was formed. And what was the result? Something, one hopes, in complete accord with Lister's simplicity and the ubiquity it gave his work. Here was an unequalled chance to arrange all Lister's articles upon inflammation and antisepsis and publish them in a very cheap form, so that every student and practitioner could buy a copy. Translation rights could also have

been made easy and inexpensive. There was a chance, in fact, to provide the whole medical world with the New Testament of the New Surgery, for nowhere can one read of the unfolding and perfection of the doctrine better than in the works of the master.

But alas for the pomp and vanity of man! The edition, which was issued by the Clarendon Press in 1909, was both cumbersome and expensive, "the two handsome volumes" of the reviewers. Their covers and price concealed Lister's characteristics by pretentiousness. The writings, that should have been in the hands of every student and doctor, were formed for the shelves of special libraries. The master was obscured, and students do not learn at the fount. They do not, in fact, learn Listerism at all. They only learn the modern elaborate complexity, which compels them later, when practitioners and attending a surgical case, to discover their own inadequacy and to be compelled, therefore, to send for one of the peculiar ring.

This happens in all spheres of life and not only in surgery. The small illustration with which this long chapter was begun demonstrates a law that pertains to all human life, whether in science, statesmanship, or, with deeper significance, religion. It is this, that if the work of genius passes through the hands of other men it invariably becomes soiled. There is only one rightful attitude towards beneficent genius—namely, that of reverent loyalty. Nor should

such loyalty be difficult, for clarity is always a feature of the work and the thought of genius. It was essentially the distinction of Lister. Whatsoever of his one studies, it is the same. " Transparent clearness, simplicity, and directness characterized his thought and speech." Before me I have his signatures in youth, middle years and age. There is no difference between them, but precisely the same qualities of " transparent clearness, simplicity, and directness " characterize them. There is no extravagance, no exaggeration. The same qualities distinguished his work, and any exaggeration and extravagance in surgical ritual and expenditure is not his. " He deplored the complications to which I have referred, which he knew from his own experience to be wholly superfluous," said Sir Hector Cameron. " From first to last he worked in old-fashioned hospitals." It was in them, as they were unchanged, that he secured his unparalleled results.

It will be a very long time before the medical world secures another Lister. It will be a very long time before any gift of such inestimable value, such simplicity, and universality of application as Lister's antiseptic system is given to the profession, and through it to the world of men. But the profession has soiled the gift with the improvements of vanity. Indeed, so obscured has the gift become, so lost is the security Lister supplied, so much unnecessary sepsis occurs and increases, that recently one of Lister's most dis-

tinguished house-surgeons told me in conversation that before long he thought a return to Listerism would be forced upon the profession. One regrets that it had not the wisdom never to leave the antiseptic system.

The members of the profession have in these latter days, by addresses, degrees, and presentations, frequently acclaimed Lister's excelling greatness. But their acclamations would have been of more genuine worth if they had taken the form of a humbler belief in his incomparable genius and a simpler adherence to his precepts and practice, and if instead of the vanity of change they had displayed the steadfastness of faith.

CHAPTER XIV

HONOURS AND DEATH

LISTER was fifty-two years of age in the year 1879, the year in which the final acceptance of the antiseptic system may be dated. From this date onwards, though opposition was not completely at an end, both faithful and unfaithful followers delighted to do him honour.

Lister had taken for his London residence No. 12, Park Crescent, overlooking the gardens of Regent's Park. At this house and at King's College he continued to pursue his researches and professional work. By research and experiment he perfected and completed the antiseptic treatment, as was described in the last chapter. In practical surgery he pursued his operative work both at the hospital and in private practice. In Edinburgh he had had a large private practice, but in London it was never very large, though many picked cases requiring careful antisepsis were sent to him from different parts of the world. At King's also the number of beds was also less than at Edinburgh, but sufficient to give him ample practice.

Lister, of course, did not confine his originality

to the antiseptic system. The same original thought which gave birth to and perfected that system was also devoted to every case and patient that came under his care. Consequently one finds a number of original operations and treatments devised by him, which by their simplicity and efficacy would have made the reputation of any man as a great surgical pioneer. The modern methods of treatment of spinal abscess, diseased joints, cancer of the breast, ununited or badly set fractures, were founded by Lister. In the other great surgical discovery of the last century, that of anæsthesia, he played a considerable part, so that after Sir James Simpson, one would be inclined to name him as the most important British scientist in this great subject. His work formed the subject of the article upon anæsthetics which appeared in Holmes's " System of Surgery " in 1861, and in it Lister laid down the first principles of the administration of chloroform, which still form the basis of the practice. The article is to my mind as remarkable as anything Lister ever wrote. It is so free from redundancy, so direct, and its emphasis upon the concentration of attention upon the respiration, and its description of the reason and right way of pulling out the tongue impart a singular confidence and understanding to the reader. The extraordinary success which Lister and his father-in-law had with chloroform show what a wonderful pair they made in this as in other branches of the art. Lister wrote a

fuller article upon anæsthetics in 1882 for Holmes's "System," which based the practice upon first principles with a lucidity and mastery which no other writer has paralleled. In the same "System," Lister wrote some fine articles upon amputation, excision of the wrist, the wiring of the patella, and other technical subjects.

As a practical surgeon Lister showed the same efficiency. At one time a curious form of attack upon the antiseptic system was for opponents loosely to state that Lister was neither a great operating surgeon nor a great teacher. As a teacher some account of him has already been given. He filled his Edinburgh lecture-hall with eager students. "As a teacher Lister was peerless," said Dr. Stewart. "His earnestness, enthusiasm, and energy were contagious." One does not see how it could well have been otherwise in a man of Lister's character and devotion.

As an operator, said the same witness, Lister chose to be slow and thorough, rather than "ambitious for a spectacular exhibition to the gallery. . . . Where there was need for speed he was not lacking in this accomplishment of a surgeon. And all who were familiar with his plastic operations must have admired these. The bold, swift, unerring strokes of his incisions, the perfect apposition of the flaps, the provision against tension, gave him better results than I have seen elsewhere. In one thing Lister was a truly great surgeon—he was of infinite resource. No unlooked-for accident, no complication, found

him unready." One reads here the qualities of a great leader, surgically displayed. "When rapid manipulation was essential," wrote Mr. Cheatle, "he was quicker and more accurate than any other operator I have seen. . . . One day I was helping Lord Lister in a case of lateral lithotomy. Dr. Hensley timed it. The operation of removing two calculi took thirty-two seconds. The onlookers were so impressed with the dexterity he exhibited that they clapped their hands. Lord Lister instantly turned round to them and said, "Gentlemen, gentlemen, remember where you are." One is recalled by this story to the skill of James Syme.

With hospital and private practice, experimental work and teaching, Lister's London days were full, but further demands were made upon his time by the many who desired to do him honour.

To give a full list of these honours as they fell to him would be tedious. The first honour he received, however, one is glad to record came from his sovereign, Queen Victoria. As a consequence of the operation he performed successfully upon her, she appointed him Surgeon to the Queen in Scotland. After his removal to London he was made Surgeon Extraordinary to Her Majesty, and eventually Sergeant-Surgeon. In 1883 she conferred a baronetcy upon him, and in 1897, the year of her second Jubilee, she raised him to the peerage, he himself wisely preserving his own great name in the title of Lord

Lister without territorial designation. He took his seat in the House of Lords in the same year, but confined his speeches to debates which had a medical or scientific character. On the occasion of King Edward's coronation in 1902, deferred owing to the King's operation for appendicular abscess, Lister was sworn a Privy Councillor. The King showed to Lister upon this occasion the royal tact for which he was so famed. " What pleased me far more than the honour of being made a Privy Councillor," said Lister to his friend, Sir Hector Cameron, " was the fact that when my turn came to step forward and shake hands with the King he said to me, ' Lord Lister, I know well that if it had not been for you and your work I would not have been here to-day.' "

Lister was frequently invited to the countries of the Continent and undertook the visits described as " almost regal " and " triumphal, not in respect of formal honours only but also of an enthusiasm, almost stupendous." They began with the tour through Germany in 1875, the tale of which has also been told. In 1883 he was invited to Pesth, and Austria and Hungary did him honour. He met with a tremendous reception. A great banquet was held and a torchlight procession of the students marched past him as he stood surrounded by the most distinguished scientists of the Austrian Empire. The occasion was rendered peculiarly happy by Dr. Duka, a Hungarian physician, who brought to Lister's

attention the name of his great but unhappy countryman, Ignatz Philipp Semmelweiss.

The history and fate of this great and unhappy man excited the liveliest interest in Lister. Here, at the completion of his antiseptic triumph, quite unexpectedly he came across a true but almost forgotten forerunner, who owing to the happy deduction of an original mind fought the unseen enemies of disease with weapons similar to Lister's, though unsupported by the scientific evidence which Pasteur had given to Lister.

No book upon Lister would be complete, therefore, without a brief account of the unfortunate physician as it was presented to Lister at Pesth, the story of a fate which must have aroused strange thoughts in the breast of the Englishman who had so recently had the acclamations of his fellow-men ringing in his ears. The contrast between the fates of Semmelweiss and Lister is a striking one, the first enshrouded in an atmosphere of darkness and hatred that deepened until it closed about his tragic death, the second enduring through opposition to be heralded with a praise, gratitude, and triumph rarely surpassed.

Semmelweiss was born in Hungary in 1818, and studied medicine in Pesth and Vienna. He was a man of penetrating observation and judgment, piercing quickly through the strata of convention and the teachings of other men. As a student he attracted the favour of two famous scientists, Professors Skoda and Rokitansky. With their help and his own ability Semmelweiss

was appointed assistant to Johann Klein, who presided over the misfortunes of the maternity department of the general hospital at Vienna. In this maternity, as in others of the time, the poisoned hand of charity plentifully scattered the seeds of putrid sickness and death. The death-rate in such maternities, as in the surgical wards, mounted with the increasing years of the "wonderful century" as the nineteenth has been named. Vienna began to grow as industrialism increased. The poor began to exchange the accustomed direction of the landed aristocracy, with its tradition of paternal responsibilities, for the impurer atmosphere of cities and the mastery of men who were controlled by no traditions and whose criterion of success lay in their own isolated prosperity and took no heed of the degradation of those whom they employed, men the nature of whose aims proved them to be lacking in the generosity and feeling heart that are essential adjuncts of the capable ruler. The result was, as might be anticipated, the rise of those terrible sufferings which, in a world of retributive justice, visit peoples who neglect to be most careful in their choice of rulers and who allow the ascendancy of the avaricious to the chief positions of authority.

Amongst the child-bearing women of the poor a condition of things arose of such unparalleled abomination that, had it continued, industrial civilization must have been abandoned as the cardinal blunder of mankind.

From the years 1784 to 1823, not one mother in a hundred, delivered in the Vienna Maternity, died. But as the nineteenth century progressed, in Vienna and in other large cities, an overcrowding of the hospitals occurred. In all the maternities an increase of disease and death resulted. In the Pitié of Paris in the years 1844-48 the deaths amongst mothers had risen to no less than ten in a hundred, and many women who escaped with their lives went out with the quality of health taken from them for the rest of their years. The General Lying-in Hospital in London showed a still gloomier record, no less than twenty-six out of every hundred mothers succumbing to the administrations of charity.

When Semmelweiss became Klein's assistant in 1846, he was struck by a contrast, which was almost as great as that between simple and compound fractures which so impressed Lister's early days. The Maternity was divided into two departments, one cared for by students and young graduates, and the other by midwives. In the first division twelve out of every hundred mothers died, in the second three out of a hundred, and previous years had shown the same remarkable contrast.

Semmelweiss added to the freshness of genius that which Lister named the first requisite of a great surgeon, namely, a feeling heart. The suffering he witnessed caused him to suffer too, and spurred him to untiring efforts to avert it. "Therein lay a terrible command to track out

the unknown causes with all my power," he said. He dismissed the orthodox theory that the fiery heat of oxygen was the inflamer of the fever of child-bed, and minutely observed every detail and incident of the maternity work afresh. He tested and dismissed conditions of situation, air, season, diet, bad ventilation, and finally came to fix his attention more and more upon the students and doctors themselves. He found that many of them came from the dissecting-room, and often without washing their hands proceeded to examine their unhappy patients. In May, 1847, Semmelweiss issued stringent orders to them to wash their hands and to soak them in a solution of chlorinated lime before they submitted the women to examinations. In the month of May, 36 out of the 294 women delivered died, but to Semmelweiss's unspeakable delight from May onwards the death-rate fell rapidly, until it reached the same level as in the midwives' department, namely, three in a hundred. The improvement, moreover, continued, and in the following year the deaths in his department scarcely exceeded one in a hundred.

With this remarkable proof Semmelweiss sought to propagate his doctrine. In Vienna many young doctors were convinced and did their best to assist him. Dr. Aneth wrote to Sir James Simpson, and gave that opponent of Lister the opportunity of forestalling his young colleague—an opportunity he rejected in a reply which Dr. Jacob Brücke, Semmelweiss's

biographer, described as insulting. Dr. Routh lectured before the members of the Royal Medical and Chirurgical Society in London. Dr. Brücke strove to interest Berlin, and Dr. Aneth lectured in Paris.

But instead of arousing earnest attention, this attempt at proselytizing on the part of some young doctors so offended the elder members of the profession that they treated it either with the indifference of self-satisfied superiority or with the hostility of insulted dignity. One cannot but deplore the reception Lister's obvious truths received in the capital of this land, but the fate of Semmelweiss was far more lamentable. His chief, Johann Klein, blinded by jealousy and vanity, stirred up the authorities and drove Semmelweiss from Vienna in 1849. Professor Skoda came forward in defence of the Hungarian, and, in spite of his repute, was made to suffer seriously for his temerity. Semmelweiss went to Pesth, and there received an appointment to the Maternity. He repeated his triumphant work, and his renewed success added to the venom of his enemies, who pursued him with all manner of persecution. Great man though he was, Semmelweiss was not so great as Lister. He had not the distance of genius, that recognition of the gap between himself and his fellow-men which enables a genius to pursue his purpose for the welfare of men undeterred by their efforts to prevent him. Semmelweiss allowed his temper to be inflamed by the envy

and maliciousness of lesser men than he. The prolonged and constant opposition of one's fellow-men can only be borne by the strongest mind. Moreover, owing to the freedom that is allotted to each man's personal opinion by the illusion of equality, genius in these latter days is doomed to be pestered by a swarm of piping Lilliputians. Even though the fight of genius be eventually crowned with success, nevertheless the original ubiquitous hostility, either open or latent, of his fellow-men, his loneliness, his perpetual need of being on his guard, and his inability to converse sincerely with any one without first converting him to his first principles, must prove a terrible strain to a really great man. Thus even Lister, though he showed the longevity of his stock, suffered markedly from mental and physical exhaustion in his last years. Semmelweiss had neither Lister's strength nor his success. Every report of an epidemic of puerperal fever, which he knew to be preventable, wrought him to a frenzy. Misunderstood and insulted by having his work dragged down to the plane of personalities and its effect upon the reputations of doctors, and never upon that of philosophy, which regards the fate of man as a whole, his mind gave way, and he died in 1865, the year in which Lister, inheriting his "karma" as a Buddhist might suggest, began his antiseptic studies. His work and almost his name were forgotten until this festival at Pesth was held in Lister's honour. From that time Semmelweiss

has been accorded a high place amongst the conquerors of disease.

Lister's acknowledgment of Pasteur as his predecessor was always freely made in his early papers, but it was not until 1874 that he took the opportunity, when sending one of his pamphlets to Pasteur, of personally expressing his gratitude and admiration in the following words :—

" I do not know whether the records of British surgery ever meet your eye. If so, you will have seen from time to time notices of the antiseptic system of treatment, which I have been labouring for the last nine years to bring to perfection.

" Allow me to take this opportunity to tender you my most cordial thanks for having, by your brilliant researches, demonstrated to me the truth of the germ theory of putrefaction, and thus furnished me with a principle upon which alone the antiseptic system can be carried out. Should you at any time visit Edinburgh, it would, I believe, give you sincere gratification to see at our hospital how largely mankind is being benefited by your labours. I need hardly add that it would give me the highest gratification to show you how greatly surgery is indebted to you.

" Forgive the freedom with which a common love of science inspires me, and

" Believe me, yours very sincerely,

" Joseph Lister."

It was not until 1881 that Pasteur was able to visit Lister and see his work. In that year he attended the International Medical Congress in London, and was received with great honour by all present. Lister gave a dinner of welcome to him, at which, though himself the host, he proposed the health of his distinguished guest in a speech that greatly affected the emotional Frenchman.

The most notable occasion upon which these two great men came together was not without occasion for embarrassment to the Englishman. It was at Pasteur's Jubilee, held in Paris in 1892, and celebrated with great pomp and fervour. President Carnot, the Presidents of the Senate and Chamber, the Ministers and Ambassadors, and the delegates of all the great academies of medicine and science throughout Europe were present. Lister represented Great Britain and Ireland, and added his address to others that proclaimed Pasteur's greatness. "Vos recherches," he said, "sur les fermentations ont jeté un rayon puissant qui a illuminé les ténèbres funestes de la chirurgie et a changé le traitement des plaies d'une affaire d'empirisme incertain et trop souvent désastreux dans un art scientifique sûrement bienfaisant. Grace à vous la chirurgie a subi une révolution complete qui l'a depouillée de ses terreurs et a élargi, presque sans limites, son pouvoir efficace." Pasteur, already wrought to a pitch of extreme motion, could no longer control himself at these words. Jumping up he

hurried to where Lister was seated, and taking the embarrassed surgeon like a child by the hand, led him to the centre of the platform and there embraced him, whilst the spectators thundered their applause and relieved their overfull hearts with sobs and tears.

Another famous reception was given to Lister at the International Congress of Medicine at Berlin in 1890. Seven thousand people were present, and Virchow was in the chair. Round after round of applause greeted each distinguished man as he ascended the tribune, but suddenly the applause strengthened into a thunderous roar of welcome, which was sustained for several minutes, and the name of Lister rang again and again through the great hall, as Lister himself, surprised and a little timid, stood before the assembly bowing his acknowledgments.

Lister did not again visit the United States, but in 1897 he attended the meeting of the British Medical Association, which was held at Toronto, and was honoured with enthusiastic acknowledgment by Canadians and Americans alike.

In Great Britain Lister received the same reverence and gratitude. Universities and academies showered degrees upon him, and various municipalities conferred upon him the freedoms of their cities.

The most interesting of these occasions were Lister's visits to his old universities, those of Glasgow and Edinburgh. He visited Glasgow in

the spring of 1894, and saw once again the wards which had been the scene of his early triumph. Before many of his old colleagues and pupils, and a number of new faces, he delivered an address. "After the address," wrote the *Lancet*, "the students became demonstrative again, sang 'Auld Lang Syne' (in which Sir Joseph Lister and his old pupils joined with evident feeling), and finally, outside the University Union, unyoked the horse from his cab and dragged the conveyance, amidst deafening cheers, from the University to Dr. Hector C. Cameron's house, a distance of over a mile. The distance was covered in a remarkably short space of time, and probably Sir Joseph Lister and his companions in peril were glad when the journey was safely accomplished. Finally, on the steps of Dr. Cameron's house, a few words were said, 'Auld Lang Syne' again sung, and the most exciting part of the visit was over. The reception of old pupils and friends, held next day at Dr. Cameron's, was equally enjoyable though altogether a quieter function."

Four years later Lister visited Edinburgh to have the freedom of the city conferred upon him. At the same time the freedom was conferred upon Lord Wolseley. Lister made a witty allusion to his association with the famous soldier in his speech. Both the professions, to which they severally belonged, dealt with great issues upon which depended life and death. The work of the surgeon was, therefore, in some respects,

analogous to that of the soldier, although happily, he dryly added, the analogy was not so close as it once had been.

Two other occasions, from the many upon which Lister was honoured, may be selected for happy expressions of gratitude. The one was in 1900 at a banquet given to Lord Lister by the leading scientists of France. Dr. Lucas Championnière, his faithful friend and follower, concluded a speech with these graceful words: "We can remember the miserable condition of surgery and how great was the mortality. Nélaton said that a statue in gold should be raised to the person who was able to prevent what we now know as 'sepsis.' You, sir, have deserved that statue." And Dr. Pinard, the famous women's doctor, at the same banquet ended his speech by saying: "Lord Lister, when we are asked why you are illustrious, we reply because you have driven back death itself; because in all you have done you have only caused tears of joy and gratitude."

The second occasion was at the banquet to Lord Lister given by the Royal Society in 1902. Mr. Bayard, the American Ambassador, devoted to Lister a few simple words of singular eloquence: "My Lord," he said, "it is not a profession, it is not a nation, it is humanity itself which with uncovered head salutes you."

Such were some incidents of the honours shown to Lister. The official list of even the most important is lengthy enough. He was made

a Fellow of the Royal Society in 1860, was awarded the gold medal of the Society in 1880, and the Copley medal in 1902, and became President in 1895. With the exception of Sir Benjamin Brodie, he was the only medical man in the century to receive that honour, and proved himself exceptionally capable in mastering and organizing the wide range of duties and scientific interests the position involved. He was President of the British Association in 1896, and of the surgical section of the British Medical Association in 1870 and again in 1875. He was made an honorary LL.D. of Glasgow, Edinburgh, Cambridge, Toronto, Montreal; D.C.L. of Oxford; Fellow of the University of London; and M.D. of Dublin, Würzburg, Pesth, Bologna, and Geneva. He was made a member of medical and scientific societies of Paris, Amsterdam, Pesth, Munich, Leipsig, Finland, St. Petersburg, and Vienna. He was also made a Knight of the Prussian Order, an associate of the Institute of France, and a Knight Commander of the First Class of the Order of the Danebrog (Denmark). With all these honours, he is still described in his latter years as one "always absorbed in his own thoughts and almost timid."

In 1893 Lister, having reached the age of sixty-six, had to surrender his appointment at King's College Hospital. In the summer of the same year he suffered an irreparable loss. He and his wife were spending the summer abroad, and whilst travelling in Italy Lady Lister con-

tracted pneumonia and died after a few days' illness. The loss to Lister was peculiarly great. The loneliness of genius has already been mentioned in this chapter. It seems to be an essential part of the distance of genius from other men, a distance which is not a gentle gradient but a real gulf. Lister resembled other genius in this. He was friendly with and invariably courteous to other men, but rarely if ever intimate. Men, howsoever devoted to him they were, were always a little afraid of him. His mood had to be awaited. Other men could not break into it without finding that they had been wanting in tact. His assistants and professional friends would sometimes have to wait some twenty minutes whilst he was pursuing a subject with his thought, before they could broach a question or a request. With women and children — again, perhaps, resembling other genius in this—he was far more at his ease. Here the gulf between them and him was the customary one between woman and man, or child and adult. The suggestion that any profound interchange was expected did not occur. With children Lister was especially happy, and with his little nephews and nieces played the most ridiculous and absurd pranks, which only a man who preserves and does not pass and forget his youth, can play and enjoy. To such a man a beloved wife forms a link of peculiar intimacy, bringing him into a closer union with his fellowmen. But when the link snaps, how much warm

and immediate intercourse with his fellows is sundered too! It was so with Lister. That rare communion of a supremely happy marriage, which made a friend declare that these continental tours, even in the last years, resembled honeymoon trips, was broken, and with it, so to speak, the bond that bound him, an essentially isolated and unique nature, most closely to his fellow-men was broken too. The blow would undoubtedly been far greater had it not been for the place in his confidence and affections which was held by his sister-in-law, Miss Lucy Syme. This lady had been for many years an invalid, and had lived much with the Listers. In the latter years of Lister's life she shook off her own illness and devoted herself to trying to fill with care and love the place of her dead sister.

In 1903 Lister had a serious illness, from which he never fully recovered, and in 1907 his general infirmity was very great. He suffered from an affection of the joints and a general wastage of body and power. He tired readily, lost his capacity for work, suffered from failing eyesight, and became, in short, a very old and worn-out man. Nevertheless, he never lost his kindly benevolence and gentleness of heart. Mr. Irving Cameron, of Toronto, a warm defender of antisepsis against the innovation of asepsis, once gave the following description of a last visit: "The last time I had the privilege of seeing him was immediately before he left Park Crescent for Walmer. I had called to leave

my card and make inquiry for him, as I always did when in town. Although I knew he was not seeing visitors, some impulse moved me to ask if he would care to see me, and being answered in the affirmative I paid him my last visit. He received me very cordially and affectionately, and said he could not deny himself to so old a friend, although he found that he did not sleep after seeing people. I at once felt that I was there under false pretences and that my distinguished clansman, Sir Hector Cameron, of Glasgow, had been expected and some confusion had arisen between the voice of Jacob and the hand of Esau. Of course I did not stay long—and learned the next day that he was none the worse for my visit—but I could not have foregone the blessing of that occasion, for when I told him as I took my leave that with my 'brother' of Edinburgh and his first disciple in Paris" (Lucas-Championnière just admitted to L'Institut de France), "I still continued to be and was likely to die an *antiseptic* surgeon, the ineffable smile was on his lips and the grasp of the ever-kindly hand made a πτῆμα ἐς ἀεί, an echo in the haunts of memory of the master's presence and my antiseptic pledge to him: while Reason holds her seat."

This was one of the last, possibly the last, visit to Lister from the outside world, and I hope the reader will share with me the gladness which I feel that it was from a faithful follower.

Broken by illness and decrepitude, Lister left

London in 1909, and lived with his sister-in-law in close retirement at Walmer, so quietly, indeed, that only his most intimate friends and relatives knew of these last years. Consequently London did not hear of his death until nearly thirty hours after its occurrence. Though the greatest of her sons, his very greatness kept him from the garishness of modern publicity.

Lister died in the early morning of February 10, 1912. His death, like that of his wife, was from pneumonia, and happened without pain.

Lister expressed the desire during his lifetime that he should be buried by the side of his wife in the Hampstead Cemetery. Though there was a general wish that he should be buried in Westminster Abbey, his personal desire prevailed.

A national memorial service was held in the Abbey upon February 16th. The King and Queen were represented, the Prime Minister was present in person. Austria-Hungary, France, Germany, Italy, and Russia sent their Ambassadors; Belgium, Denmark, Greece, Sweden, Norway, and Portugal their Ministers. Representatives of all the leading scientific bodies at home and abroad were present. Besides these representatives a large number of distinguished men attended. The service was brief but impressive. The anthem chosen was Handel's "When the ear heard Him." As the last words sounded, "His body is buried in peace, but his name liveth evermore," some felt, one thinks, the strange and

awful prescience that comes to men when the meaning of immortality trembles upon their earthly consciousness. For this service was dedicated to a name and work over which death shall have no power. It proclaimed the qualities of paternal solicitude and provident goodness to be related, not only to the earthly years of man but also to the timeless perfections of divinity.

CHAPTER XV

CONCLUSION

ONCE more, with the reader's permission, we will return to the philosophy of disease, in which Lister fills so important a place, for it is limiting his powers and value to consider him chiefly as a surgeon. Lister was far more than that. His early work upon the vitality of the tissues and its issue in his lifework have enabled us to get a comprehension of disease as a whole which in value surpasses and includes the subsidiary work of making modern surgery possible.

It must be clear, I think, to the reader who has been impressed by the terrible stories of the hospitals in our industrial centres before the advent of Listerism or of the maternity hospitals as recorded in the last chapter or of the Crimean and Paris hospitals at times of war that mankind, when crowded into small spaces, when shut from the open heavens and the air cleansed by sun and rain, and when divided from the food of field, forest, and stream, only receiving it in the cities after it has lost its pristine purity, a purity which is unanalysable but as definite as the purity of the air at dawn or any other supremely vital

thing, that it is then that disease casts the shadow of death upon man and obscures in no small measure the glory of life.

It must be clear, I think, that men when crowded together, either for the purposes of industry or those of war, no sooner become wounded than they tend forthwith to harbour microscopic forms of life and to foster them into forms of ever-increasing malignancy, until such men in association may be looked upon as veritable forcing-houses of pestilence, breeding from microbes, which are harmless to healthy vitality, monstrous demons of disease fraught with the power to torture and to kill.

First the cramped town or camp and then the yet more cramped hospital, and the imprisoned man suffers for his loss of freedom. The decreased vitality of man rears the microbe to a colossal importance, just as the same crowded conditions resulting from competitive industrialism give a creed of the struggle for existence a seemingly universal but really epochal importance.

In the case of the diseases of hospitalism all this is quite clearly shown by Lister's life and work. These diseases were a peculiar product of civilization, and especially of its peculiar phase known as industrialism. They were rendered possible in all their awfulness only by the accumulative effect of a generally weakened human vitality. For in so far as industrial civilization meant a separation of man from the

original sources of food and health, in so far as it led to close concentration in cramped towns and crowded factories, so men had to pay for it by the contagious currency of disease.

And casting the eye over a wider range than this most recent phase of civilization—namely, the industrial—one sees that these peculiar features of it do not wholly vanish and disappear. One sees that the first separation of man from an immediate relation with the natural sources of health and vitality, however so good the intention of men may be, is met with a loss of human vitality and the prominence of some lower forms of life, which in nature seem to be only the servants of death, but which in man affect him seriously when alive and cast upon him the actual shadow of death. It may, of course, be maintained that this is not strictly true, that even wild and living animals suffer from microbic diseases. But relatively it is true. The wild animals in the natural state very rarely die of such diseases. The microbes only overcome their bodies when dead so as to effect putrefaction. But an active state of putrefaction in the living animal seems to be exceedingly rare. Put upon the animal, however, any of the restraints of civilization and the tale at once becomes a different one.

The very first disease of animal life that was found to be due to microbes disclosed this secret. It was one of the diseases of silkworms, known as flacherie, and investigated by Louis Pasteur when Lister was at Glasgow. The microbes of

flacherie were found to be powerless with naturally fed worms placed upon wild mulberry-trees. But the overcrowding of the worms in the litters, the artificial temperature, the lack of free flow of air, and the indigestible leaves of pruned and cultivated mulberry-trees so lowered the vitality of the worms that they fell victims in millions to the microbes of flacherie.

The same decreased vitality, which had such a ruinous influence upon the silk industry in France, is noted in the domesticated animals of civilized man. Amongst cattle, who might be said, as animals, to live a life of luxury and ease, the commonness of tuberculosis is well known, and it is a part of the price they pay for the fatted life. But tubercle is not the whole price, for, like other domesticated animals, they are subject to all kinds of sicknesses unknown to them in the state of freedom. Cancer, for example, the disease which in foulness is the most horrible, is practically or even completely unknown amongst wild cattle, horses, sheep, goats, or deer; but Mr. Rollo Russell writes, in the only philosophic outlook upon cancer with which I am acquainted, "it is much more common amongst domesticated creatures, such as cows, pigs, poultry, and fattened beasts, more common in cats, and most in dogs." Cancer is, in fact, part of the payment which these animals have to make for the advantages of civilization which man has thrust upon them.

Civilized man has the same payment to make

in fuller measure, and where he is most civilized there his payment is heaviest. The payment in "hospitalism," until Lister checked it, was heavy enough, but it did not record the full payment of industrial towns in rickets, insanity, nervousness, venereal disease, alcoholism, deformities, difficult childbirth, the loss of the zest for life, which collectively are still as marked as ever. As yet, also, cancer has been wholly unchecked, for no philosopher, such as Lister was, has read its secrets, only the surgeons treat it. Cancer consequently forms a good measure of man's payment for being civilized, for the peculiar loss of human vitality that permits it to cast its shadow upon man seems to increase step by step with man's gain in civilization. It is a disease of towns above all, and where the population is most wealthy there cancer also reaps its richest harvest. But where civilization, and particularly European civilization, is not advanced, there cancer is as yet powerless. "The countries of immunity," writes Mr. Russell, "or where cancer is rare, were: most of Northern, Central, West, East, and South Africa, where natives were apart from civilization or European customs; a large part of Asia, especially the tropical regions, where habits were frugal, or where certain peculiar customs were not prevalent; large parts of India, China, Burmah, and Siam; many of the islands, especially New Guinea and Borneo; the native locations in Australia; the Fiji Islands, parts of the West Indies; parts of Brazil and of Mexico;

and apparently native Java and Sumatra. . . . Races and persons little subject to cancer very quickly become subject on entering new conditions where European or American fare is taken. This applies to negroes, Chinese, and apparently all races. Europeans accustomed to their ordinary moderate fare quickly become more subject after they have changed to richer fare."

It is the same story with the disease, which in horror alone rivals cancer—namely, tuberculosis. Practically everybody who lives in modern towns suffers at some time from tuberculosis, said Professor Metchnikoff, in the Priestley Lecture of 1912. "It is well known that tubercular disease has spread all over the world—in tropical regions and the islands of the Pacific and Atlantic, and such regions as South America and South Africa, once free from tubercle, but now exposed to it by the immigration of Europeans." The Professor gave an instance of this change, which was personally known to him. The Kalmuks are a group of nomadic shepherds, and were found by the Professor to be free from tubercle, especially when they were living at a distance from the influences of the Russian civilization. Nowadays a large number of Kalmuk boys come to Russian towns for education, and secure not learning only but tubercle as well.

That which was seen in Lister's lifework seems, then, to be no isolated picture, but one

that marks civilization. It seems, indeed, that the answer to the mystery of disease may almost be given—namely, that it is the debt man pays when he allows his civilization to lead him away from certain primary habits of life. But I hasten to say that, philosophically regarded, it is not a punishment for not leading what is now known as the simple life. A civilization of the highest culture and imperishable grandeur, such as the ancient Egyptian, may be founded upon the simplest physiological and bodily habits. Complicate those habits and remove them from the primary sources of health, and disease, with its various specific kinds and forms, becomes a perpetual accompaniment of life. Disease is allied to death; it is itself the shadow of death. And so one comes to see that certain forms of civilization that are not founded upon and permeated by physiological laws are in themselves allied to death. They neglect what in nature seems to be the ultimate aim—namely, the cultivation of a refined and perfect vitality, the highest excellence in the quality of life; until, if retributive justice be indeed a law of Providence, the neglect of the rightful interpretation of the true purposes of being leads to the shadow of death clouding the brightness of men's days.

Through its own sickness a civilization has to be healed or else to be destroyed. History is full of records, in which peoples of more crude animal health swept away civilizations that had occupied centuries in the building. But our

civilization represents a peculiarity unique in the history of the world. Unless the Yellow Peril one day proves itself a reality, or the hosts of Africa, under the marvellous inspiration of the Arabs, sweep over an effete Europe—both possibilities that at present seem scarcely credible—our civilization, if sick, is bound to cure itself. There are no people of rude health capable of sweeping it away.

That it has been and is still seriously sick, physiologically and bodily sick, no reader of these pages can, I think, doubt. It is no exaggeration to say that had it not been for Semmelweiss and Lister, industrial civilization might have come to a standstill through the number of mothers slain, the number of men destroyed, the accumulation of the maimed and the invalid.

Of these two Semmelweiss became forgotten, but Lister succeeded; and it is significant, with a significance that is startling, that he, the most effective genius of his century in the general interests of humanity, had to turn his vast powers upon the problem of putrefaction, and, in place of more positive fields of labour, had to make himself the master of corruption. It was he, above all men—above Semmelweiss, above Pasteur, above all the many speculative philosophers of the age—who realized the primary fault which civilization had brought about, namely, the weakened vitality of man, and especially of the men upon whom that civilization pressed most

heavily. As he first saw the vitality of the frog's web paralysed, so he saw man in part paralysed and all the allies of death making triumphant assaults upon his weakened defences. To this partial human paralysis he brought the truest ally. The antiseptic, microbe-killing power of man's blood and tissues was too weak, and Lister brought to it a true and philosophical ally—namely, an antiseptic lent to the body for so long as it had need of it. By so doing he turned the failure of the unaided powers into a triumph. He not only showed the root and cause of the great prevalence of microbic diseases (and, by inference, other diseases)—namely, the weakened vitality of man, but he also showed how the disasters due to this weakened vitality might be averted.

It is clear, however, that the aid which he brought was comparable to that of mercenary troops. It was hired aid; and, indeed, so long as the conditions producing this weakened vitality prevail, so long must we rely on hired aid. But of all hired aid that of antiseptics is the most philosophic, in that it is the most generally applicable. When once the antiseptic has reached the microbes, there are none that can finally resist. It does not matter what the peculiar microbe is that reaches the wound, carbolic will be able to destroy its danger.

The other well-known method of coming to the aid of the diminished vitality of man is by the use of vaccines and serums. Serums are

special antiseptics which destroy special microbes and none other, and their value depends upon the doctor being able to detect the peculiar brand of the microbe that is already actively producing disease in the body. When the disease is actually there the injection of the right serum does sometimes help the body to overcome the disease, but the method can have no general application, and has always to await the onset of the disease. The vaccine, on the other hand, increases the power of the blood to overcome one particular form of microbe. The method of vaccination was founded, not upon a philosophical understanding of vitality but upon the experience of dairymaids and cowkeepers. Jenner's work was empirical, Lister's philosophical. The danger of empiricism is that it is always specific ; its value depends upon a particular case or conditions. But a philosophical treatment, being founded upon a general principle, has a general application. The philosophy of vaccination, one may say, does not really exist. There is in it no unified principle. Experience alone has shown that in certain diseases an attack, even if slight, seems to guard a man against another attack. But this is only true of certain diseases. With a number of other diseases one attack, in so far from conferring immunity, actually predisposes the patient to further attacks—malaria, dysentery, pneumonia, influenza, and common colds being examples. Therefore the vaccine method of aiding the diminished vitality of man, which

would require a separate vaccination for every separate disease, is not even feasible. The most one can say for the vaccine method is that where one particular disease prevails in a threatening manner, then if it can be staved off by a method of vaccination its use is legitimate. But such a method is not philosophical or fundamental; it is only specific and empirical. It seems even possible that a vaccine protects against one disease by concentrating the blood's vitality against that disease and so weakening its resources against other diseases and degenerations. One may, in fact, make a cream from the blood to resist a certain disease and be left with only skim milk for the rest—a process only justifiable if the particular disease is especially threatening to life itself.

Therefore, so long as man suffers from a weakened vitality which makes him peculiarly liable to disease, and so long, therefore, as he needs an antiseptic ally, Lister's method seems to be the wisest and most philosophical. By it, when man is wounded and there is in him a local point of microbic attack, the aid of antiseptics may be directly and temporarily given to him. By it all foci of putrefaction that occur particularly in cities, such as drains, rubbish-heaps, dead animal matter, as well as the actual discharges of infected wounds and people, may have their danger destroyed.

Until, therefore, some national physiological régime is established which has for its aim the

cultivation and preservation of the vitality, which makes so many diseases impossible, a medical profession adhering to a strict antiseptic orthodoxy would do untold good. But orthodoxy is necessary for several reasons. Firstly, it limits the freedom of choice which is at present allowed to men incapable of right judgment in difficult matters; secondly, it produces a unity of performance the general results of which can be estimated; thirdly, it simplifies action greatly and prevents the chaotic muddle in which medical practice at present exists, and in which new and unproven remedies are constantly being offered to the medical practitioner, they being advertised either by articles in the medical papers or directly by tradesmen and manufacturers—a muddle that would be far worse were not the practitioner prevented from using his freedom to try any of these remedies by his own inertia and lack of time; fourthly, it would give confidence to the public, who would know more or less what to expect from a doctor and what to do themselves to help him, instead of the lack of confidence generally felt owing to the total inability of the laity to know where one particular doctor has fixed his temporary faith; lastly, it would give to the profession the form of an art and of organization in place of the disintegrated confusion of a competitive trade. I think, therefore, that no better tribute could be paid to Lister than by the issue of a cheap copy of his works, which all medical students

should be compelled to read. Further, operations and midwifery, conducted with Lister's antisepsis, and in the former case with his exact technique, should be shown to the students, and "Listerism" should be made one of the subjects of the final examination. Only in this way can the full benefit of Lister's great personality be reaped by the profession and, through them, by the public.

With this training in orthodox Listerism, one or two lectures upon Lister's personality and life might well be combined. There is no personal or ethical training in the whole course of a student's training to-day. It is as if ethics and personal character had nothing to do with the practice of medicine—at least nothing sufficiently definite to permit of speech. Yet the indication to students of a certain ethical standard is as necessary to ensure the best practice of orthodoxy in the medical profession as it is elsewhere. As Professor von Mikulicz-Radecki, one of Lister's early pupils and friends, said of the antiseptic system, so one may say of medical practice in general: a special quality of character is required to its employment as well as technical instruction—namely, a character of precision and consistency. It was characteristic of the founder of the system and is necessary in the follower. "If this quality is wanting to any one, he will remain, in spite of all ability, a bungler in the treatment of wounds." And the inculcation of this quality could scarcely be

better attempted than by holding up the personality of Lister to the students and doctors of the day.

For as the antiseptic system in its simplicity, effectiveness, and general application is an ideal aid to civilized man against microbic ills, so the character of Lister was that of the ideal physician. We cannot, of course, all have genius, we cannot all have the qualities of excellence in the abundance with which they were granted to Lister. But the supreme example of an exalted personality is ever of great value; it always forms a definite ideal at which to aim. It has seemed to me, though I myself belong to the profession, that medical men in sacrifice, sense of duty, and kindness of heart surpass the members of any other way of life. Our calling is sometimes said to produce callousness, but I believe all will agree that the callous doctor is far rarer than the kind. It is truer, I believe, to say that the profession of healing attracts boys of kind and generous humanity, and that, when they become men, the suffering they see amongst men, women, and children broadens and deepens the feelings of their hearts.

To-day, in the stress of competition that arises out of the general eagerness for wealth, the humaner qualities of mankind have not, perhaps, the same chance to ripen and flourish as in days when the family rather than the individual was of chief importance. In the past a practitioner's

relation to his patients was more intimate, he forming almost another member of the family. To-day this happy position is less frequent. The need of regarding a practice as a business enhances the commercial qualities to the detriment of the more kindly feelings of service and solicitude. Though I believe doctors as a whole are less affected by this general change than any other class of men, still the example of Lister's character is a gift of quite equal value to that of the antiseptic system; but it is one at present neglected. In the whole of my student career no lecture was ever given upon Lister's work and character. Lister was, of course, at that time in active work, and no doubt lectures upon his character would not have been so seemly as they would be now. But now that he is dead his quality should be memorized in the mind of every student.

For, as one closely related to him recently said to me, probably no man ever went through life with less regret and more to rejoice in than Lister. In an even higher sense than of old he was a saint, for he dispensed material and bodily good in addition to the spiritual power, which every one gained who came into close contact with him. No man ever carried out a great revolution, and yet won, with very rare exceptions, from all who opposed him but became personally acquainted with him, a more generous admiration and respect. He was strong, but he was gentle; he was resolute, but courteous.

When he first became a surgeon to the Glasgow Infirmary by his firmness he resisted and prevented the overcrowding that was common to the wards of the hospital. He would not allow expediency or the need of standing well with the managers to interfere with efficiency. The same firmness was his throughout his life. Based upon his direct observation of the good that resulted from his work, he was inflexible in its pursuit. No desire to protect his own person from attack ever drew him from his work, unless the attack was directed against his honour. No attack against his work ever distracted him, unless it was from one whose authority might do it serious hurt. His answers were then brief and to the point, and his only rebuke a quiet irony. In all the controversy and hostility his innovations provoked his judgment was admirable. True to himself, he never allowed animosity to disturb the serenity which was necessary to the cool and untroubled continuation of his work and the dispassionate criticism he devoted to it. His serenity was absolute and won the praise of his foes. His sense of the high nature of his calling was peculiarly vivid. "To intrude an unskilled hand to such a piece of divine mechanism as the human body," he was wont to say, "is indeed a fearful responsibility." It was this sense of responsibility, a responsibility particularly heavy in the case of a man of his unequalled powers, that caused Lister to devote such unwearying energy to the allevia-

tion of suffering humanity, that almost as a whole seemed to have been placed by Providence in his charge. It was this that made him, a man of sufficient private means to enjoy most of the luxuries of life, to follow a life of extreme simplicity. It was this that made him devote the early morning hours month after month to the laborious experiments, which the neglect of some trifling precaution or a little laxity in thoughtful carefulness would have rendered useless.

His courtesy was invariable, and he treated all with the most gentle consideration. But it did not prevent him from rebuking people, where a rebuke was justly merited. On one occasion, for instance, a pompous, bustling practitioner introduced himself to Lister as an old college friend. It was when the antiseptic system was well established. The practitioner expressed his surprise at the strangeness of fate. "Here are we, Sir Joseph," he said. "I am unknown and you famous everywhere for this antiseptic system. Not that there is anything in it. I would not let any of my patients have any of these new-fangled methods. I would not even try them on any one." "Sir," replied Lister quietly, "if your patients knew what I know, they would not let you enjoy the honoured name of a physician."

"A feeling heart is the first requisite of a surgeon," Lister once replied to a questioner. It was the feeling heart that above all directed

his life. It made him to his family a member of deep affection, loved and respected by the elder members, delighted in by the younger members, amongst whom he readily became the child, using his creative power to invent romp or story with originality and variety such as children especially love. To his faithful partner in life he gave a love and tenderness that caused his friends to speak of husband and wife in their last years together as like lovers on their wedding trip. The impulses of the heart of a really noble nature in the family show themselves in intimate affection, in the outer world in a tender solicitude to and unwearying thoughtfulness for others. To his students and those who served him Lister showed the bounty of an acknowledged master, zealous in giving them all the share of his power that they could take. He did not only give them the lectures and classes, which were their due, but whenever he had spare time he would devote it to them, giving them the peculiar skill that he alone could give. On Sundays, we are told, in the morning he would attend church with his wife, but in the afternoons, instead of taking his ease, he would go to the infirmary at Edinburgh, accompanied by his keenest pupils, and there talk over cases and treatment with them. He was ever ready to welcome pupils and doctors to his house if he had experiments to demonstrate or records of work and cases to show them. Foreigners and countrymen all testify to the unfailing care and patience with

which he again and again unfolded his doctrine to them. In money, too, he showed the same generosity, helping students, professors, and scientists alike. A friend of his, for instance, mentioning a poor student who had no money to finish his course received at once a cheque for £50 from Lister to be given to the student with his best wishes. He was one who was wont to presuppose a goodness in other men of like kind to his own—a characteristic which, whilst usually calling forth the best in other men in response, sometimes led him to be imposed upon by unworthy applicants for his help. He trusted men so much that he was wont to leave his fees to what they considered just and right.

To his poor patients he showed the same care as he showed to the rich. "He likes the little yins best and the auld women," whispered a street urchin who was under his care as the chief passed from the boy's bedside. His solicitude for his patients was unremitting, and, as he was one whose gifts were never partial, he always staunchly refused to turn a patient from the hospital, though months were taken up in the last stages of a lingering recovery. He did not understand a lesser sense of humanity. "When Lister left Edinburgh in 1877," said Mr. Grasset, of Toronto, one of his favourite house-surgeons and author of an affectionate memento, "there were eight cases in his wards of psoas abscess—seven men and boys and one woman. Lister

thought they would remain in the hospital under a mandate until they got well. Dr. John Stewart tells me that shortly after Lister went to London it was decided to turn these patients out. Caird wrote to Stewart and asked if the girl, a lady's-maid from the South of England, would be taken in at King's. 'I shall never forget,' he says, 'the pained look of surprise in Lister's face when he heard his patients were turned out.' I wired Caird, 'Yes,' and that night she left for London under the care of a nurse, transported in one of those long baskets which in Edinburgh were used to carry patients to the operating theatre, manned by the dressers of the surgeon. She ultimately got quite well, and the 'chief,' writing a year or two later, said that he had seen her walking and looking bright and well. Lister had the men and boys taken from the infirmary to a nursing home where he used to operate in Edinburgh. He put them under the care of his old assistant, John Bishop, and paid all the expenses connected therewith, including attendance and dressing. In the end all of them got perfectly well."

Such was the perfection of his paternal solicitude for all who were committed to his charge. And it is fortunate that one of the greatest problems in the fate of man was submitted to him and that, prompted by his great compassion and made capable by his consummate genius, he mastered it and became therefore a benefactor to mankind in such bountifulness that his equal

could scarcely be found amongst the children of this world.

Lately I was standing beside his grave in the Hampstead Cemetery. A plain, grey granite slab covers it, upon which man has written the simple inscription: "Joseph, Baron Lister, born 5th April, 1827; died 10th February, 1912." The memory came to me of the legend of St. Sophia and of the angel's hand which wrote upon the slab above the western door. And I thought that upon this grey slab some angel hand might also write without profanation the noblest of texts: "And all generations shall call me blessed."

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